Semantic Web Fred

Michael Stollberg
DERI
University of Innsbruck, Austria
michael.stollberg@deri.org

Reinhold Herzog
Net Dynamics
Vienna, Austria
reinhold.herzog@netdynamics-tech.com

Peter Zugmann
Net Dynamics
Vienna, Austria
peter.zugmann@netdynamics-tech.com

Abstract

Semantic Web Fred, SWF for short, is an environment for automated cooperation in the Semantic Web, combining agent technology, ontologies, and Semantic Web Services. The SWF technology applies emerging techniques for Semantic Web Services and presents a system that combines the technological building blocks identified for the Semantic Web. This poster introduces the objectives of the SWF project as well as the architecture and workflow of automated cooperation developed within SWF.

1 Introduction

Different key technologies for the Semantic Web have been identified: Ontologies for semantically enhanced information exchange over the web, Web Services for reuse and interoperability of computational functionality, and agent technology for automated execution of tasks [Berners-Lee *et al.*, 2001]. These technologies have to be combined in order to exploit the full potential of Semantic Web applications. The objective of the SWF project is to develop a system for automated cooperation that combines these technologies, thus providing a significant contribution to the development of technologies for the Semantic Web and Semantic Web Services.

In SWF, agents, called *Freds*, perform tasks automatically on behalf of their owners. According to the paradigm of agents as autonomously acting entities in a software environment, Freds have to interact in order to resolve their distinct tasks. Therefore, a Fred has to find a suitable cooperation partner as well as the computational resources required for automated task resolution. With regard to a service-oriented architecture as envisioned for Semantic Web Services, the main building blocks of SWF are Goals and Services [Fensel and Bussler, 2002]. A Goal represents a task that a Fred has been assigned, and a Service is a computational resource that allows automated resolution of Goals. The SWF project develops advanced mechanisms to identify possible cooperation partners and to execute such cooperation between agents.

The starting position for the SWF project is the FRED system, an environment for cooperative agent-based applications that allows import of ontologies and integration of external Web Services developed by Net Dynamics [Stollberg *et al.*, 2004], and the Web Service Modeling Ontology WSMO which aims at developing an overall framework for Semantic Web Service description and technologies.[1] The SWF project is funded by Austrian government under the CoOperate programme 2003, and was awarded as the 2nd best proposal in the call.

2 SWF Architecture

The SWF architecture shown in Figure 1 relies on a real-world cooperation model: for solving a complex task, several parties have to interact. A cooperation will only take place if it is profitable for all partners, as nobody offers a service without getting something in return. Following this, the a Fred in SWF has a Goal (which is the task assigned by its owner), and it has Services that

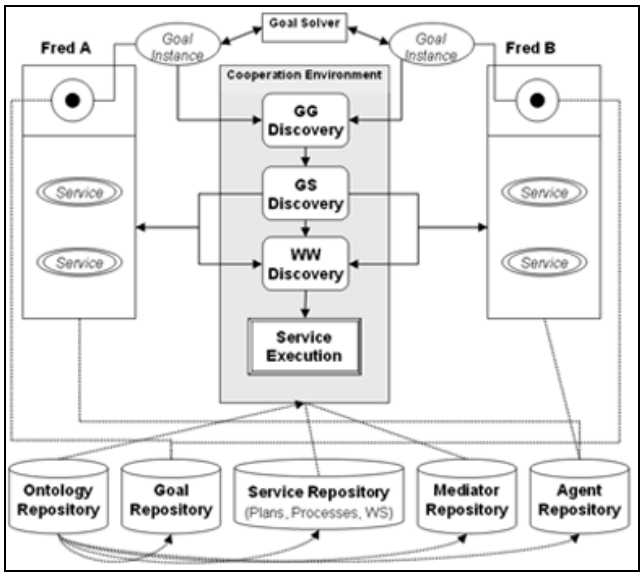

Figure 1: SWF Architecture

[1] WSMO hompage: www.wsmo.org

provide the functionality the Fred has to perform as a party participating in a cooperation.

Other components of the SWF system are Ontologies that provide the formal terminology used by every other component and Mediators for resolving potential heterogeneities between resources. All components are stored in specific repositories. The following explains the concept of Goals, the SWF Service Model, and the mechanisms for automated cooperation in more detail.

2.1 Goals

A Goal represents a desire that a client has, and that he delegates to a Fred for automated resolution. Goals are described by a postcondition, specifying the result that is to be achieved, and by effects that a requested to hold after resolution of the Goal. So-called Cooperative Goals define compatible Goals that can be resolved in a cooperation. SWF distinguishes Goal Schemas and Goal Instances: the former specifies the ontological structure of Goals as pre-defined desires that can be resolved by the services existing in the system, while the latter is an instantiated Goal as a concrete expression of a desire at a certain point in time which carries additional information (Goal Owner, creation date, and status of resolution).

2.2 SWF Services

There are three types of Services in SWF: *Plans* are internal Java-programs; *Processes* which are multi-step services wherein each activity can be resolved arbitrarily by a Goal or another Service, thus establishing the possibility to define complex, nested services; *external Web Services* can be used via their WSDL-description. The description language for SWF Services considers the overall notion of Services, as for discovery mechanisms only the descriptive information are of interest; the actual type of a Service is only of interest for execution (the execution environment are: JVM for Plans, a Process Engine for Processes, and an executor for WSDL). The description elements for SWF Services are aligned to those for Web Services in WSMO: *Capability* as a functional description, *Interface* as the behavioral description, *Grounding* for Service type resolution, and *non-functional properties* for management of Services.

2.3 SWF Mechanisms

The centered gray box in Figure 1 shows the mechanisms for Cooperation Execution. These are inference mechanisms implemented with different reasoners. The following explains how they establish automated cooperation.

GG Discovery

At first, potential cooperation partners have to be detected. GG Discovery matches Goals: the Goal Owners (i.e. Freds) are sent into a cooperation negotiation if their Goals are compatible according to a Cooperative Goal, and if the objects of desire are matching. For example, a Buyer and a Seller have compatible Goals within a Cooperative Goal 'purchase', and they have 'chair' as their object of desire.

GS Discovery

Next, each partner has to find the Services that he needs for the cooperation. Therefore, GS Discovery matches Goals and Services as 'conventional Web Service Discovery', resulting in assignment of suitable Services for each cooperation partner.

WW Discovery

For automated execution, the Services detected for each partner have to compatible with regard to their behaviors. This is checked and established by WW Discovery, resulting in a choreographed service execution contract for the cooperation.

Cooperation Execution

When the discovery mechanisms have been completed successfully, the contract derived by WW Discovery is executed. This includes invocation of Services and their execution as well as error and compensation handling.
After successful service execution, the Goals of the cooperation parties are resolved. The overall process of a SWF Cooperation is monitored by the SWF Goal Solver as shown in Figure 1.

3 Conclusions & Future work

The development in the SWF project concentrates on the specification of the Goal and Service Description Language and on the development of the mechanisms of automated cooperation, as the FRED system already provides the needed agent-technology as well as the facilities for service execution, and WSMO provides a conceptual model for Semantic Web Services.
Currently, SWF is designed for a closed FRED environment. It is planned to extend the SWF technology to a web environment; therefore, only specific components have to be adopted, while the general architecture and components do not have to be changed. Also, follow-up projects are planned to enhance specific SWF components.

References

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