STORE - Stochastic Reputation Service for Virtual Organisations

Jochen Haller

Abstract Virtual Organizations (VOs) are an emerging business model in today's Internet economy. Increased specialization and focusing on an organization's core competencies requires such novel models to address business opportunities. In a VO, a set of sovereign, geographically dispersed organizations temporarily pool their resources to jointly address a business opportunity. The decision making process determining which potential partners are invited to join the VO is crucial with respect to entire VO's success. A reputation system can provide additional decision support besides the a priori knowledge about potential partners. To achieve this in this demonstrator, reputation, an objective trust measure, is aggregated from multiple independent trust sources that inherently characterize an organization's reliability. To allow for the desired predictions of an organization's future performance, a stochastic modeling approach is chosen. This demonstrator presents a research prototype of the full Reputation Service for VOs including a web based User Interface.

1 Introduction

Virtual Organisations (VOs) are an emerging business model in application domains with a high demand for cross-domain collaborative business processing. Increased collaboration among frequently changing, previously unknown business partners and focusing on an organisation's core competencies requires such novel models to address busi-ness opportunities. A VO is defined as a set of sovereign, geographically dispersed organisations that temporarily pool their resources to jointly address a business opportunity one organisation alone is not able to master [1]. This demonstrator consists of the Web

SAP Research, e-mail: jochen.haller@sap.com

Service based STORE reputation service [2] that delivers reputation based decision support for a business partner selection to an organization playing the role of a VO manager. The VO manager is tasked, among other duties, with the VO formation by identifying and inviting trusted business partners.

2 Description

The STORE research prototype, more concretely the service provider implementation, consists of three types of Axis Web Services[1], deployed in a Tomcat Web Container. Figure 1 depicts the services and their interactions which are described bottom-up in the following paragraph:

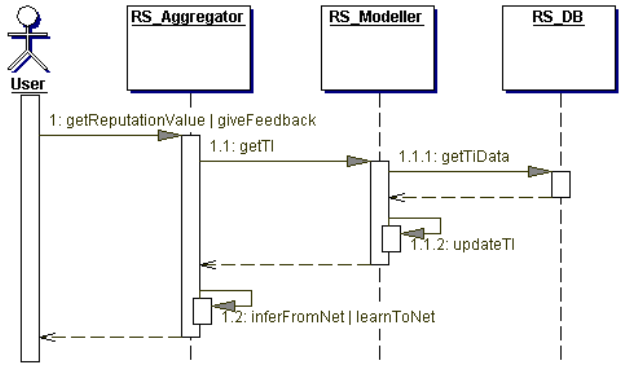

Fig. 1 Service Interaction Sequence Diagram

An organisation's (the trustee) reputation is based on so-called Trust Indicators (TIs), observable properties characterising the organisation's trusting behaviour. The database Web Service (RS_DB) collects the observed data for each TI which can then be retrieved by the TI Modelling Web Service (RS_Modeller). The latter service models each TI, according to a TI taxonomy, with probability density functions. Each TI is modeled in the taxonomy with individual attributes. These attributes entail a name, unique identifier, time interval in which period new data can be observed, a distribution assumption, etc. Delivery delay for instance is assumed to be exponentially distributed, since a trustworthy organisation is characterised by decreasing probabilities the higher a delay in days becomes. New data for this TI can be typically observed on a daily basis. Instead of a direct density estimation, a more robust posterior distribution $P(\theta|X)$ is calculated according to the Bayes Theorem.

[1] http://ws.apache.org/axis/

$$P(\theta|X) = \frac{P(X|\theta)P(\theta)}{\sum_{S} P(X|\theta)P(\theta)}$$

Newly observed data θ is hereby entering the equation as the emprirical distribution $P(\theta)$. The distribution assumption, denoting how a particular TI is expected to evolve, shapes the likelihood distribution $P(X|\theta)$. The latter also takes an organisation's past behaviour in form of historic data X into account. The denominator normalises the posterior distribution over a discretised time axis with states S.

The demonstrator implements the five TIs Cash Flow Quote, Country Bond Spread Index, Employee Fluctuation Rate, Delivery Delay and System Downtime with data fitting a large Brasilian company from the manufacturing industry. The third Aggregation Web Service (RS_Aggregator) infers an organisation's reputation value from the set of its characterising TI's posterior distributions[2] using a Bayes Network (BN). A BN can be represented by a directed, acyclic graph, where each node holds a random variable with a conditional probability depending on its parents. The tree topology used in this demonstrator aggregates the TI posterior densities as evidence (leaf) nodes and the expectation value of root node's density delivers the reputation value.

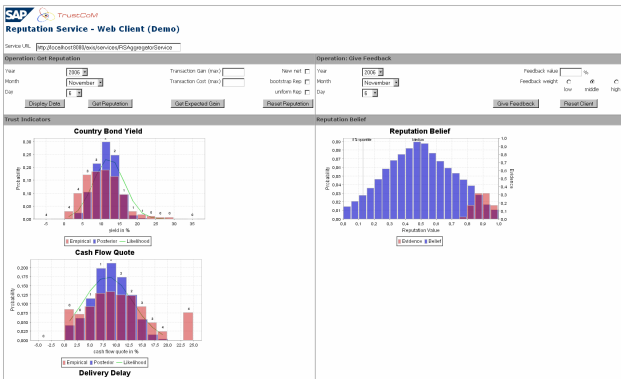

Fig. 2 Servlet User Interface (UI)

A VO Manager's representative (the trustor) who is interested in a potential VO member's reputation accesses the STORE service through a servlet generated UI using a standard Web Browser (Figure 2). A feedback mechanism to rate a selected VO member after conducted collaboration is also available.

[2] http://plato.stanford.edu/entries/bayes-theorem/

References

1. T.J. Strader, F. Lin, and M.J. Shaw. Information structure for electronic virtual organization management. *Decision Support Systems*, pages 75–94, 1998.
2. Till J. Winkler, Jochen Haller, Henner Gimpel, and Christof Weinhardt. Trust indicator modeling for a reputation service in Virtual Organisations. *The 15th European Conference on Information Systems (ECIS)*, 2007.