A Mobile Agent Based Approach for Business Processes Automation

Ernesto López-Mellado, CINVESTAV Unidad Guadalajara, Zapopan, Mexico
Marina Flores-Badillo, Intel Tecnologia de Mexico S.A. de C.V., Tlaquepaque, Mexico

ABSTRACT

The paper addresses specification and development of large and complex management systems for business process based on a multi agent systems approach. A methodology for obtaining workflow specifications is presented; it is based on conceiving the management system as a mobile agent system in which mobile agents guide the workflow processes within the organization. The specification includes the work environment, the agent behavior, the process plans, the tasks, the resources, and the interaction protocols. The obtained descriptions are modular and hierarchal leading to clear and compact structuring of the distributed software. The design methodology includes a guideline for Java based coding. Finally, key issues for extending the agent based method to address inter-organizational workflow management are overviewed.

Keywords: Agent Behavior, Business Process, Management Systems, Mobile Agents, Workflow Automation

1. INTRODUCTION

Nowadays Information Systems (IS) are designed for individual task execution control allowing coordinating, monitoring, and supporting the logistical aspects of a business process, in other words, the IS has to manage the flow of work through the organization.

The WorkFlow Management represents a critical issue for achieving enterprise competitiveness among organizations. Many companies have realized that the business processes (BP) within their organizations, and between the companies and their partners have not been clearly described and there are not enough techniques and methods to automate the processes.

The Workflow Management Coalition (WFMC) states that workflow (WF) is concerned with the automation of procedures where documents, information, or tasks are passed to the participants according to a defined set of rules to achieve, or contribute to, an overall business goal (WFMC, 1999). Another definition of WF can be found in (Rusinkiewicz & Seth, 1994) where workflows are activities involving the coordinated execution of multiple tasks performed by different processing entities (persons or machines). A task or process involves a piece of work and a process entity which executes the work.

WorkFlow Management (WFM) is a fast evolving technology which is increasingly being exploited by businesses in a variety of industries. Its primary characteristic is the automation of
processes involving combinations of human and machine-based activities (Aalst & Hee, 2002; Aalst, 1998).

A Workflow Management System (WFMS) provides procedural automation of a business process by management of the sequence of work activities and the invocation of appropriate human and/or IT resources associated with the various activity steps. Although the most prevalent use of WFMS is within the office environment in staff intensive operations such as insurance, banking, legal and general administrations, etc, it is also applicable to some classes of industrial and manufacturing applications (WfMC, 1995). WFMS needs to integrate other technologies such that agent technology, which provides flexible, distributed, and intelligent solutions for business process management.

This work presents a methodology for mobile agent-based WFMS development. The proposed methodology consists of a modular and gradual specification of the system where a mobile agent guides the process through organizational and executes different tasks. Several mobile agents evolve through the system executing concurrently their assigned task.

2. BACKGROUND

2.1. Agent Based Workflow Management

The notion of agent in Yuhong, Zakaria and Weiming (2001) is used as “a computer system situated in some environment, which is capable of autonomous action in this environment in order to meet its design objectives” (different notions can be found in Wooldridge (2002) and Nwana (1996)). These works also highlight the benefits of applying agent technology to business process management; some of these benefits are: distributed system architecture, the inherent autonomy of software agents because agents can start a WF based on event trigger, the agent reactivity because it have the ability to generate alternative execution paths, etc. An intelligent agent is capable of autonomous operation and flexible behavior in order to meet its design goals and also has the properties of reactivity, pro-activity, and social ability (Wooldridge, 2001).

In other works both concepts are integrated. In Repetto, Paolucci and Boccaletti (2003), a methodology for the design of agent based WF was presented; it consisted in three steps. In the first step the authors model the BP with UML Activity diagrams by identifying all the necessary resources and activities. In the second step, all the activities identifying roles in parallel paths are grouped. Finally, they define an agent for each group.

Several researchers took the agent technology for the improvement of WF applications. In Marin and Brena (2005), architecture for high-level agent-based WF is proposed. On this architecture they break down the WF execution and the process flow control in small execution units handled by intelligent agents and a WF processes is controlled in a decentralized way.

A collaborative approach for workflow systems is presented in Savarimuthu and Purvis (2004) where agents collaborate by forming a social network (societies); in Savarimuthu, Purvis and Fleurke (2004) agents are embedded in a system that can monitor and control the overall functioning of a workflow process in an agent based WF system. In (Minhong, Huai-quing & Dongming, 2005), agent technology is used for the WF monitoring where various intelligent agents working together to perform flexible monitoring tasks in an autonomous and collaborative way. Other proposals dealing with collaborative workflow management using agent technology are presented in Flores-Badillo (2008), Xu (2008), and Xu (2009).

2.2. Multi-Agent Systems

Mobile agents are autonomous programs that can travel from one computer to another under its own control. They offer a robust and efficient framework to develop distributed applications including mobile applications.

A stationary agent is executed only on the system where it began its execution. If it
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