Metadatabase Meets Distributed AI

Gilbert Babin, Zakaria Maamar and Brahim Chaib-draa

{babin,maamar,chaib}@ift.ulaval.ca
Département d'informatique, Université Laval
Ste-Foy, Québec, Canada, G1K 7P4

Abstract. Heterogeneous Distributed Database Management Systems (HDDBMS) involve the interoperability of data sources. One approach to achieve this type of integration is to build interfaces between the different databases being integrated. This approach holds, for a particular case, at a specific point in time. In this case however, the database structures need to be adapted. Such adaptation is not advisable since the local systems are usually important for their organizations. Therefore, an integration model that assures flexibility and scalability must be based on some knowledge of the underlying model of the different local databases. One solution is the use of the metadata concept, as a means to describe the logical and physical data characteristics. The metadata concept leads to the development of a Metadatabase system, which is viewed as a knowledge base about the local systems. The Metadatabase work at Rensselaer Polytechnic Institute (Troy, New-York) [11] and Université Laval (Ste-Foy, Québec) [2] has focused on creating such an integration environment and on defining its principal components. These solutions have been developed outside the context of Distributed Artificial Intelligence (DAI) and would certainly benefit from the results in that field of research. In this paper, we explain how the Metadatabase approach can be mapped into or associated with DAI concepts, and how it could benefit from techniques and theories pertaining to the DAI field.

1 Introduction

The computer network domain and the globalization of economy have forced the enterprises to adopt a distributed structure which, in turn, implies a distribution of resources of those enterprises, particularly their information systems. In this case, it becomes more and more important to provide enterprises with integration tools to consolidate the information available throughout the distributed databases. The integration concept is supported by an interoperability process which means the ability of two or more distributed database systems to mutually exchange information, independently of their constraints of distribution and heterogeneity, in order to work together to execute well-defined and delimited tasks jointly. Notice that the integration approaches traditionally proposed assume the interoperability at the application level (i.e. between local systems)
via a global schema or a common manipulation language [6,18]. On one hand, designing a global schema implies the combination of different kinds of domains in one model which is generally difficult to obtain and to maintain. On the other hand, finding a common language is not easy because each system has its own standards and needs. One original solution to the integration problem that assures flexibility and scalability is the use of the metadata concept. This concept lead to the development of a Metadatabase system, that is, a knowledge base about the logical and physical data characteristics of local systems.

The Metadatabase work at Rensselaer Polytechnic Institute (Troy, NewYork) [11] and Université Laval (Ste-Foy, Québec) [2] has focused on creating an integration environment and on defining its principal components, producing a Metadatabase-supported, Rule-Oriented concurrent systems solution to the enterprise information integration and management problem. These solutions have been developed outside the context of Distributed Artificial Intelligence (DAI) and would certainly benefit from the results in that field of research, like using the software agents as modules for the problem resolution [14] and the multiples techniques (interaction, cooperation, negotiation, etc.) as principles for the behavior specification [15].

In this paper, we explain how the Metadatabase approach can be mapped into or associated with DAI concepts, and how it could benefit from techniques and theories pertaining to the DAI field. Section 2, which follows, describes in more details the Metadatabase approach and the internal functions of ROPE shells. In Section 3, we give an overview of the Distributed Artificial Intelligence (DAI) field and its application to the distributed Knowledge Based-Systems (KBS). Section 4 investigates the use of DAI to improve the Metadatabase integration approach. We conclude the paper in Section 5.

2 The Metadatabase Approach

Rensselaer's Metadatabase approach [3,4,12,13] was developed to integrate information systems, more specifically manufacturing systems. Manufacturing systems are heterogeneous and distributed by nature. To produce finished goods, many systems must cooperate. These systems might include an Order Processing System, used to record customers' orders, a Process Planning System, determining the steps to follow to obtain finished goods, and a Shop Floor Control System, dealing with process planning, job assignment, production status, etc. These systems are highly specialized, in the sense that only certain systems can perform specific tasks; for instance, only certain machines can drill a hole into a sheet of metal, for instance. These systems are also autonomous; each one manages its own database, which makes data consistency an issue. The problem then is how to coordinate the tasks performed by each of these systems and integrate the information stored in their local databases.