



Chapter XI

An Information Management Environment based on the Model of Object Primitives

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INTRODUCTION

The explosive emergence of distributed computing environments and component-based architectures increases the demand for flexible information modeling paradigms. A review of the state-of-the-art shows that contemporary modeling methods and technology, such as object-orientation (OO) and CORBA, facilitate to an extent the functional integration of heterogeneous information management systems. However, there are still issues to be resolved that mainly involve (i) the inflexibility of modeling semantics adopted by OO methods, (ii) the complication of developing new service components and their deployment in a distributed management environment.

This chapter attempts to pinpoint some of those difficulties and suggests ways to overcome them. In this direction, we give a short overview of the problems encountered in the current state-of-the-art that act as motivation for this research. In response to challenges identified, we then continue on two main strands of analysis, one theoretical and one practical. In the theoretical part we introduce the *Model of Object Primitives*. It aims at providing a more flexible way to model information. The main objective here is to simply pinpoint the basic principles and elements of the model and not provide a thorough analysis of its semantics. The semantics of the

model is analytically described in (Georgalas, 2000). Finally, in the practical part we present an information management architecture that adopts the idea of primitives in order to build components and deliver information services to client applications.

MOTIVATION

Modeling languages present several shortcomings in terms of their flexibility to model information at a conceptual and logical level. Examples of such modeling languages are XML, RDF, UML, the Object and the Relational data model. Their basic disadvantage is the adoption of complex semantics as main part of the modeling language. These semantics are aimed to handle special cases. A characteristic example is the notion of inheritance, or *isA* relationship. IsA is a particular type of association between classes where the subclass inherits all the properties (attributes, relationships) of its superclass. An isA can be *overlapping* or *disjoint* depending on whether it is permitted for superclass instances to be shared or not among the subclasses. A *total participation* constraint on an *isA* determines that *all* instances of the subclasses are as well instances of the superclass. In *isA*, classes might be enforced to inherit *from only one* and not more superclasses (a class in Java inherits only one class, but can inherit more than one interfaces). Furthermore, *isA* can also be *strict* or *selective* depending on the capability of a subclass to inherit the properties of all or only some of its superclasses (ECR model of Elmarsi-Navathe (Elmasri, 1994)). Another example of complexity is the constraints that characterise relationships (e.g. in EER or OO). We have cardinality constraints that determine the membership of the associated entities i.e. whether the relationship is 1:1, 1:N or m:n. Additionally, an entity is considered to *totally participate* in a relationship R if *all* the entity instances are R-related to the instances of another entity. We refer every interested reader to (Georgalas, 1998) where more examples of such semantics and their complications are extensively studied.

The semantics plurality introduces a major obstacle when a need emerges for the integration of *information* that is modelled in different languages. When integrating data sources, several representational transformations are carried out to guarantee the compatibility between the integrated parties. In Federated-DBMSs, for instance, Amit Sheth suggests in (Sheth, 1990) a model of five subsequent transformations to the schema of component databases before they participate in the federal system. The databases support different data models such as relational, OO and XML. The final *external schema* is expressed in a common, semantically rich, modeling language. Such languages are usually EER or OO that are quite expressive because of the very specialised semantics they adopt. Since the transformations are carried out using these specialised semantics, schema translation turns out to be a complex, non-optimal and inflexible process.

Another problem that appears, involves the integration of *behaviour*. Such a situation occurs when constructing component-based applications, where a number of software modules become integrated by means of middleware like CORBA or DCOM. Components express their behaviour in interfaces that are defined in an *Interface Definition Language (IDL)* and are published to client components through *Brokers* (a client requests an interface from a broker which in turn contacts the

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