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Model Driven Development of Secure XML Databases

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ABSTRACT
In this paper, we propose a methodological approach for the model driven development of secure XML databases (DB). This proposal is within the framework of MIDAS, a model driven methodology for the development of Web Information Systems based on the Model Driven Architecture (MDA) proposed by the Object Management Group (OMG) [20]. The XML DB development process in MIDAS proposes using the data conceptual model as a Platform Independent Model (PIM) and the XML Schema model as a Platform Specific Model (PSM), with both of these represented in UML. In this work, such models will be modified, so as to be able to add security aspects if the stored information is considered as critical. On the one hand, the use of a UML extension to incorporate security aspects at the conceptual level of secure DB development (PIM) is proposed; on the other, the previously-defined XML schema profile will be modified, the purpose being to incorporate security aspects at the logical level of the secure XML DB development (PSM). In addition to all this, the semi-automatic mappings from PIM to PSM for secure XML DB will be defined.

1 Introduction

Though relational database (DB) technology still plays a central role in the data management arena today, we have seen numerous evolutions of this technology, such as the XML DBs. A key requirement underlying those recent data management systems is a demand for adequate security. Fine-grained flexible authorization models and access control mechanisms, in particular, are being called for [1]. Traditionally, the information of XML documents was stored directly in XML files or in conventional Database Management Systems (DBMSs), by mapping the XML data to relational data stored in relational tables or by using the data types supplied for supporting file management, as for example the CLOB (Character Large Object) type. The XML DBs are now emerging as the best alternative for storing and managing XML documents. At present, there are different solutions to store XML documents, and they could be roughly categorized, according to [25], into two main groups: native XML DBMSs like Tamino [23]; and XML DB extensions enabling the storage of XML documents within conventional, usually relational or Object-Relational (OR) DBMSs such as Oracle. This latter includes, since version 9i release 2, new features for the storage of XML (Oracle's XML DB) [22]. In [25] a study of different XML DB solutions is performed.

For most organizations, management, security and confidentiality of information are critical topics [6]. Moreover, as some authors remark, information security is a serious requirement which must be carefully considered, not as an isolated aspect, but as an element that is present in all stages of the development life cycle [5,11,13]. A body as important as the Information Systems Audit and Control Foundation insists on the fact that security should be considered explicitly and as an integral item in all the development stages of an information system [15]. In the case of the XML DBs, security is also a key aspect that must be explicitly considered. It has to be taken into account in an orthogonal way for the complete development process of this kind of DB. Access control models have been widely investigated and several access control systems, specifically tailored to XML documents, have been developed [2,3,4,12,14,18]. However, all of them define security criteria directly over the XML documents or DTDs.

Our approach is based on the Model Driven Architecture (MDA) proposed by the Object Management Group (OMG) and allows us to define the security specifications on the conceptual data model, independently of the target logical data model (DB schema). Starting from this secure conceptual data model we transform it semi-automatically into a secure XML DB, as a logical data model.

Although there are different ideas for integrating security into the information systems development process, information security within the scope of DBs tends to be considered only from a cryptographic point of view. Recently, we have proposed a methodology for relational DB which integrates security aspects at
also analyze the advantages of incorporating security aspects provided by the different XML DB administrators, not only native ones, but also the XML extensions that DBMSs have. At the same time, we are going to include the security aspect in the subsystem for the semi-automatic development of XML DBs of the tool CASE that we are developing.

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