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Time Cost Evaluation of Trust Based Access Control for XML Databases

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Abstract— **XML databases are widely used in many different areas. They are multi user systems and can store a huge amount of data. Sensitive and important data need to be protected and stored securely. We have developed a dynamic trust based access control for XML databases to improve the security level and prevent malicious transactions from both internal and external users. Our system tracks user history of errors and bad transactions and updates the access privileges depending on trust values. In this paper, we evaluate the use of trust based access control by measuring the real time cost. The experimental work is performed to test the access time with and without trust based access control and suggests that the approach, though costly is not prohibitively time consuming.**

Keywords- XML databases; security; trust based access control; evaluation.

I. INTRODUCTION

XML databases are an active research topic due to a recent increase in their use [1, 2, 3]. As with any database, they can contain sensitive and important data; therefore, it is imperative to be able to provide a secure environment to deal with it. Secure systems need access control to manage access to the data and prevent unauthorized and malicious processes.

Access control models for XML databases can be categorized into the discretionary access control model (DAC) [8], the mandatory access control model (MAC) [6, 7], and role based access control (RBAC) [4, 5, ~~6, 7, 8~~]. Traditional access models are limited in that they are static and focused mostly on protection from outsiders.

Access control is one of the main issues in XML databases that need further investigation. There has been extensive research in this area but many points still need to be developed. At present there is no gold standard for access control in XML databases [9, 10].

Trust based access control is an established technology and used in many areas, such as networks and virtual organizations [11, 12, 13, 14, 15]. It depends on a trust management system, which automatically calculates and updates the trust values of users. Trust values rely on users' behaviors, histories, credit, and operations. Users can access resources for which their trust value is appropriate.

In our previous work [16, 17, 18, 19, 20, 21, 22], we proposed, implemented, and evaluated applying trust based access control for XML databases. The model tracks users' errors and bad transactions over time and updates their privileges dynamically. It prevents outsiders' attacks as well as insiders' malicious processes, effectively preventing users from taking advantage of their role.

In this paper, we measure the real time cost of applying trust based access control for XML databases. Our experiments aim to evaluate the access time with and without trust based access control. The remainder of the paper is organized as follows. Section 2 describes the structure of our trust based access control. Section 3 explains the experimental results for the time consumed with and without trust based access control. It illustrates the results of several experiments that have been run with different size databases. Section 4 forms the conclusion and suggests future work

II. TRUST BASED ACCESS CONTROL (TBAC)

In this section, the components of trust based access control for XML databases are explained. The system consists of trust module and access control module.

The trust module focuses on observing users' behavior by recording and evaluating bad transactions and errors. The access control module aims to make access decision depending on the organization's access policies. Each of these two modules contains many components.

The trust module includes an operation recorder, an error detector, an operation evaluator, and a trust calculator. The operation recorder registers both errors and bad transactions in an Xlog file [18, 19, 20, 21, 22].

The error detector and the operation evaluator depend on policy files that define what an error or a bad transaction is. The trust calculator calculates the new trust value depending on three factors: existing trust value, error factor, and bad transaction factor.

The access module consists of the access manager, which works in the light of access policies files, and the access decision maker, which is responsible for handling the query and either permits or denies the request.

The next section describes experimental results evaluating the performance of trust based access control by measuring the cost in time.

III. EXPERIMENTS' RESULTS

In this section, the comparison experiments are described. The main goal of these experiments is to evaluate the performance of our trust based access control. These experiments aim to evaluate the time required to apply the trust concept in access control for XML databases by comparing the time with and without the system.

All experiments were performed on a PC with 2.83 GHz Intel® Core™ 2 Duo CPU E8300. The system of trust based access control is implemented using Java Language and Net Beans platform framework. We used Xmark benchmark to generate many XML databases with different file size. Table I shows the size of each XML databases used in the experiments.

TABLE I. THE SIZE OF XML DATABASES.

File Name	Size
F1	0.027 MB
F2	0.56 MB
F3	1.15 MB
F4	2.3 MB
F5	5.7 MB
F6	7 MB
F7	10.1 MB
F8	15 MB
F9	20.2 MB
F10	25.5 MB
F11	30.2 MB

For simplicity, we tested only read privilege through two queries. The first is a simple query

[Q1: //site/open_auctions/open_auction/initial].

The second is a complex query that includes joins of ancestor-~~descendant~~ descendants

[Q2: //listitem//keyword].

The number of users was selected to be 50 as its minimum because the aim of these experiments is to measure the access time with and without trust based access control and not to check the scalability in the number of users.

Figure 1 and 2 show the results of access time for both Q1 and Q2 in 11 different sizes of XML databases with and without trust based access control. The time consumed for trust based access control is obviously longer than the time consumed without it in both queries.

In Q1, the time for trust based access control increased markedly when the size of files increased. The normal time to access the file 0.027 MB is 31 milliseconds while the time consumed for trust based access control for the same file is 49 milliseconds. Then the time for trust based access control increased sharply to reach 3863 milliseconds when the file size is 30.2 MB. The time is double the normal time to access the 30.2 MB file.

The results of Q2 are similar to the results of Q1. In Q2, the time starts at 50 milliseconds when the file size is 0.027 MB and then reaches 4076 milliseconds when the size of file is 30.2 MB. When the file size is 0.027, it needs around 32 milliseconds. Then the time increased gradually to reach 1971 milliseconds when the file size is 30.2 MB.

From these experiments' results, we conclude that the ~~consumed time~~time consumed for trust based access control is around 1.5 to 2% of the normal access time and is not markedly affected by the complexity of the query. ~~Time for TBAC/time without TBAC= 1.5 ~ 2.~~

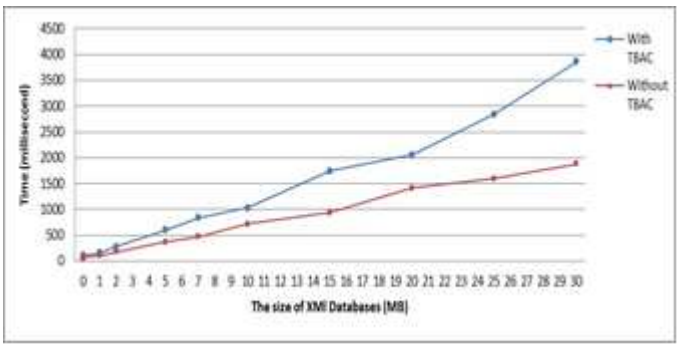

Figure 1. The results of Q1.

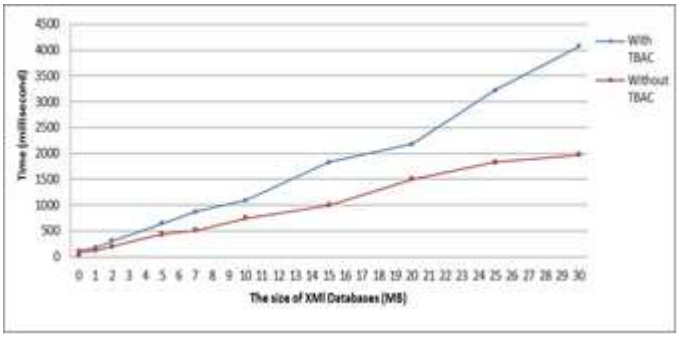

Figure 2. The results of Q2.

IV. CONCLUSION

The trust based access control consumed more time but it is important to tackle security problems in XML databases to reduce misuse and the time cost is not excessive.

Improving access control work is vital to protect sensitive data and provide a secure environment for users. Trust based access control improves the security in XML databases by observing user history of errors and bad transactions. It mainly depends on using evaluation processes to prevent misuse and encapsulate the access process to make it more secure.

Applying trust access control for XML databases links accessing concepts and updating privileges depending on logging technique. One of the most important features of trust-based access control is that it is dynamic, which ~~can make~~makes the access systems responsive and active.

In this paper, we measured the real time required to use trust based access control ~~and~~ compared with the normal access time. The experimental results show that the time consumed for trust based access control increases markedly when the size of the XML databases is increased.

The results for both the simple and the complex queries are similar. The comparison results of testing the access time with and without trust based access control system suggest it is worth persevering with this work. We plan to apply trust based access control for relational databases in our future work.

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