Abstract

Attribute based access control (ABAC) has been emerging as a suitable choice for access control due to its flexibility in expressing various types of security policies. In ABAC, subjects are granted access to resources based on the set of attribute values they are associated with. However, the flexibility of ABAC comes with increased complexity of the system makes management of attribute assignments a tedious job, which that cannot be done single-handedly. Access control policies of an organization can be enormous and might involve hundreds of subjects and thousands of resources. Moreover, to ensure appropriate access control, they are often associated with constraints. Since access control mechanisms, which are instantiation of access control models, are used to enforce these policies, it is of utmost importance to understand and analyze the security properties of access control models prior to their deployment in any system. This dissertation focuses on designing a comprehensive administrative model for decentralized administration of ABAC systems, enforcement and verification of constraints in ABAC and security analysis of ABAC in the presence of the proposed administrative model.

In this work, we present an attribute based administrative model for ABAC, named as AMABAC. It uses ABAC itself to administer a user ABAC system (an ABAC system without administrative components). AMABAC includes a set of twenty administrative relations and commands to manage the various components of ABAC. While administrative relations define the set of attribute values an administrative user should be associated with in order to perform modifications in the components of user ABAC, administrative commands are used for performing the actual modifications.

Next, we introduce the problem of SoD verification in ABAC (ABAC-VF-SoD) and the problem of SoD enforcement verification in ABAC (ABAC-EF-SoD) in ABAC systems. While ABAC-VF-SoD aims at verifying whether a set of policies is enforced in a state of an ABAC system, the objective of an instance of ABAC-EF-SoD is to verify whether a set of SoD policies remains enforced across state transitions. The problem of ABAC-VF-SoD has been proved to be CoNP-complete and two different approaches have been proposed for solving it. Based on the different scenarios in which solving an instance of ABAC-EF-SoD is required, different classes of ABAC-EF-SoD problems have been identified and their solutions have been discussed. Effectiveness of the proposed solutions for solving the instances of ABAC-EF-SoD has been evaluated using a large set of experimental data sets.

Finally, we present methodologies for performing security analysis of ABAC

systems in the presence of AMABAC. The analysis has been done using the Alloy analyzer and the μZ tool. The Alloy analyzer is a SAT based model checker and μZ is a fixed point constraint solver developed as an integral part of Z3 SMT solver. Both are freely available and have been widely used for verifying properties of a system. Impact of the various components of ABAC as well as AMABAC on the time taken for analysis has been studied.

Keywords: *ABAC, Administrative model, SoD verification, SoD enforcement, Security analysis, Alloy analyzer, μZ*