Chapter 2.2
Grid Access Control Models and Architectures

Antonios Gouglidis
University of Macedonia, Greece

Ioannis Mavridis
University of Macedonia, Greece

ABSTRACT

In recent years, grid computing has become the focal point of science and enterprise computer environments. Access control in grid computing systems is an active research area given the challenges and complex applications. First, a number of concepts and terminology related to the area of grid access control are provided. Next, an analysis of the Role Based Access Control (RBAC) and Usage Control ABC ($UCON_{ABC}$) models is given, due to their adaption from the grid computing systems. Additionally, a presentation of well known grid access control architectures illustrates how the theoretical access control models are implemented into mechanisms. In a comparative review of the examined access control models and mechanisms, their pros and cons are exposed. Apart from the mapping of the access control area in grid computer systems, the given comparison renders valuable information for further advancement of current approaches.

INTRODUCTION

The grid is an emergent technology that can be defined as a system able to share resources and provide problem solving in a coordinated manner within dynamic, multi-institutional virtual organizations (Foster, Kesselman, & Tuecke, 2001).

This definition depends mostly on the sharing of resources and the collaboration of individual users or groups within the same or among different virtual organizations, in a service oriented approach. The grid's unique characteristics, such as its highly distributed nature and the heterogeneity of its resources, require the revision of a number of security concepts.

Trust, authentication, authorization and access control are some of the security concepts met in grid systems, as these are identified in the existing literature (Gouglidis & Mavridis, 2009). In this chapter, we will further examine the latter of the aforementioned. Access control is of vital importance in a grid environment since it is concerned with allowing a user to access a number of grid resources. An extensive research has been done in the area of access control in collaborative systems (Tolone, Ahn, Pai, & Hong, 2005; Zhang, Nakae, Covington, & Sandhu, 2008). Nonetheless, further examination is demanded. This is mainly due to the partially or weak fulfillment of the access control requirements in grid systems.

The aim of this chapter is to provide the reader with a comprehensive report on the access control models and architectures currently used in grid computing systems. The value of this chapter is the mapping of the grid access control area, so as to assess the applicability of access control solutions in modern grid applications. Along with the identification of a number of core grid access control requirements, a comparative review of access control models and mechanisms determines their pros and cons. The results from the comparison greatly value the applicability and appropriateness of both models and architectures in being used in grid systems.

The structure of the remainder of this chapter is as follows. The next section provides a prerequisite terminology used in access control, in the context of grid systems. Furthermore, a number of grid access control requirements are presented. An analysis of the Role Based Access Control and the Usage Control models follows. In addition, an examination in regard to the implementation of the theoretical access control models into mechanisms is displayed. A complementary discussion section provides a comparative review of all the examined access control models and mechanisms, respectively. Finally, we present our concluding remarks along with some future thoughts.

BACKGROUND

This section introduces the basic concepts and terminology, related to grid systems and access control. A presentation of the access control process and the identification of core grid access control requirements follow.

Terminology and Access Control Concepts

As mentioned in the definition of the grid, terms such as users, resources and services play an important role. To this effect, we explicitly set the following definitions, mainly based on (Benantar, 2005; Chakrabarti, 2007; Ferraiolo, Kuhn, & Chandramouli, 2003; Foster & Tuecke, 2005; Ravi S. Sandhu, 1994).

A *service* is an implementation of well defined functions that are able to interact with other functions. The Service Oriented Architecture (SOA) is comprised of a set of services that can be realized by technologies such as the web services.

A *domain* can be defined as a protected computer environment, consisted of users and resources under an access control policy. The collaboration which can be established among domains leads to the formation of a virtual organization.

A *user* in a grid environment can be a set of user identifiers or a set of invoked services that can perform on request one or more operations on a set of resources. Furthermore, we identify two types of users. These are the resource requestor and the resource provider. The former type of user acts like a resource access or usage requestor, and the latter type of user acts like a provider of its own sharable resources. All users are restricted by the policies enforced in their participating domains and virtual organization.

A *resource* in a grid environment can be any sharable hardware or software asset in a domain and upon which an operation can be performed.

Access control's role is to control and limit the actions or operations in the grid system that are

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