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Analysis of Secure Mobile Grid Systems: A systematic approach

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Resumen

Developing software through systematic processes is becoming more and more important due to the growing complexity of software development. It is important that the development process used integrates security aspects from the first stages at the same level as other functional and non-functional requirements. The identification of security aspects in the first stages ensures a more robust development and permits the security requirements to be perfectly coupled with the design and the rest of the system's requirements. Systems which are based on Grid Computing are a kind of systems that have clear differentiating features in which security is a highly important aspect. Generic development processes are sometimes used to develop Grid specific systems without taking into consideration either the subjacent technological environment or the special features and particularities of these specific systems. In fact, the majority of existing Grid applications have been built without a systematic development process and are based on ad hoc developments.

The Mobile Grid, which is relevant to both Grid and Mobile Computing, is a full inheritor of the Grid with the additional feature that it supports mobile users and resources in a seamless, transparent, secure and efficient manner. Grids and mobile Grids may be the ideal solution for many large scale applications since they are of a dynamic nature and necessitate transparency for users. A Grid infrastructure that supports the participation of mobile nodes will thus play a significant role in the development of Grid Computing.

A development methodology for Secure Mobile Grid Systems is proposed in which the security aspects are considered from the first stages of the life-cycle and in which the mobile Grid technological environment is always present in each activity. In this paper, we define the complete analysis activity (using SPEM 2.0, one of the software process modelling standards), we define all tasks, integrate the new defined artifacts (focused on security and reuse), and allocate some of the most representative ideas of the security requirements engineering discipline. In the development of this methodology, we apply the action–research method in order to incrementally improve and refine our approach, and we are currently applying this activity to an actual case study (which is being developed in a European project).

This paper presents the analysis activity which is focused on ensuring that the system's security and functional requirements are elicited, specified and modelled. In

our approach, this activity is driven by use cases and supported by the reusable repository. This obtains, builds, defines and refines the use cases of the Secure Mobile Grid Systems which represent the functional and non-functional requirements of this kind of systems. These use cases have been defined through a UML-extension for security use cases and Grid use cases which capture the behaviour of this kind of systems.

A brief description of each activity is defined as follow:

- Defining UC of the application. This task studies and defines the actors and use cases involved in the system but considers only the use cases that interact with the client apart from the mobile Grid environment.
- Identifying secure mobile Grid UC. In this task, a study of the system security must be carried out before identifying the security use cases and misuse cases of the repository. First, the assets that we wish to protect should be identified; second, the possible threats and attacks to these assets should be defined and, finally, the risk associated with these threats should be studied.
- Building a secure mobile Grid UC diagram. Once all the use cases (from the application and the repository) and the actors that take part in the system have been identified, the overall use case diagram is built. In the repository, not only the use cases and actors, but also the relationships between Grid use cases (UC, security UC, misuse case, mobile UC and actors) which can be reused for the system diagram are defined.
- Supporting with UML models. A detailed description of use cases needs other models to complete the dynamic aspects that cannot solely be described with use cases. These models are the sequence and collaboration diagrams which are related to use cases or use case scenarios and help to capture some aspects of the behaviour which are not captured with the definition of use cases.
- Verifying analysis model. This task verifies whether the analysis artifacts have been correctly generated, and whether the different UML diagrams which have been defined to complement the use case view according to the UML profile are related and coordinated to correctly define and describe the behavior of the different scenarios identified from use cases diagrams.
- Specifying requirements. In this task, we have sufficient information regarding 'what' the system does, and it is therefore possible to specify the requirements identified, defined and described which fulfil the initial needs.

A wide set of elements which are common to these systems are stored in the repository, as are secure mobile Grid use cases, interaction diagrams, UML profiles, templates, etc., which help the analyst to define all the requirements (functional and nonfunctional, and security in particular) and build the necessary diagrams with which to complete the analysis activity from beginning to end. Our development methodology is being applied to one application of the media (news) sector. The methodology is helping us to build a Mobile Grid application, which will allow journalists and photographers (media domain actors) to make their work available to a trusted network of peers at the same moment as it is produced, either from desktop or mobile devices.

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