**Faculdade de Engenharia da Universidade do Porto**



**Physical Access Control System**

**Mestrado Integrado em Engenharia Informática e Computação**

**Métodos Formais em Engenharia de Software**

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**Abstract**

On this report we present a formal, tool-supported approach to the design and maintenance of access control policies expressed in the eXtensible Access Control Markup Language (XACML). Our aim is to develop an application using the model-oriented specification language from Vienna Development Method (VDM++), capable of perform actions based on targets, subjects and subjacent policies, and therefore apply the specified policy combination algorithms to determine its outcome status (e.g., denial, permit, etc.).

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# **1. Introduction**

## **1.1 Project Description**

This project aims to develop a physical access control system using XACML[[1]](#footnote-1) language, implemented in VDM++, in order to perform authorization, identification, authentication, access approval and keep records of all succeeded or failed access requests.

## **1.2 Objectives**

The physical access control system should have the following features:

* may be used in all sorts of physical facilities, such as hotels, schools, banks, military facilities, etc.;
* should be able to control the access to buildings, sectors (inside a building), rooms, parking lots, floors (in elevators), and other facilities;
* each authorized user is given a contactless card to present at appropriate access points, communicating with NFC (near field communication) or other means;
* access cards may be temporary, with a defined date-time of expiration (e.g., for hotel guests);
* each access card has a unique identifier and access cards may be reused;
* both users and facilities may be organized into groups (e.g., students, teachers, classrooms, computer laboratories, etc.) to facilitate the definition of access rules;
* a user or facility may belong to multiple groups;
* access policies are defined by means of access rules;
* each access rule specifies a user or group of users, a facility or group of facilities, and possibly a temporal constraint (a specific date-time interval, a recurrent time interval, etc.);
* rules may be defined as exceptions to other rules (e.g., to deny access for some period of time);
* the system should be able to decide on access requests;
* the system should keep a log of all succeeded or failed access requests.

## **1.3 Requirements**

## 

# **2. UML Modeling**

On this section it’s presented the use cases and conceptual model for this project, as well as additional notes and constraints concerning the diagrams.

## **2.1 Use Case Diagram**

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## **2.2 Class Diagram**

Conceptual modelling is the abstraction of a simulation model from the part of the real world it is representing - “the real system” (Robinson, 2008). After collecting the necessary requirements, we achieved the following conceptual model, represented by (Figure 1):

# **3. VDM++ Modeling**

## **3.1 Classes**

## **3.2 Data Types**

## **3.3 Domains**

# **4. Model Validation**

## **4.1 Test Classes**

## **4.2 Test Results**

## **4.3 Requirements Traceability**

# **5. Model Verification**

## **5.1 Domain Verification**

## **5.2 Invariant Verification**

# **6. Code Generation**

# **7. Conclusions**

## **7.1 Results Achieved**

## **7.2 Improvements**

## **7.3 Effort**

# **References**

Bryans, J. W., & Fitzgerald, J. S. Formal Engineering of XACML Access Control Policies in VDM++. Newcastle University, School of Computer Science. Newcastle: Newcastle University.

Robinson, S. (2008). Conceptual Modelling for Simulation Part I: Definition and Requirements. Journal of the Operational Research Society.

1. XACML – eXtensible Access Control Markup Language [↑](#footnote-ref-1)