Electronic Student Identity Card Management System

at the Poznan University of Technology

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Summary

The electronic student identity card is a mandatory identification document certifying the status of being a student. The paper presents requirements the electronic student identity card must comply with and comprehensively reviews the existing electronic student identity card management systems. It also describes in detail the solution designed and developed at Poznań University of Technology that enables to use the electronic student identity card both within the university as well as for providing agglomeration services.

Introduction

Public universities are an important part of the public sector in Poland. In Poland education in public schools is free of charge. Public universities educate nearly 1.5 million students every year. An additional 0.5 million attends private schools. Each student receives a *student identity card*, which is a mandatory identification document certifying the status of being a student. Many universities extend the number of functions performed by the card, like college applications or urban services. The paper objective is to present an electronic student identity card system combining the functionality of various public services.

The first section presents legal aspects of the electronic student identity card in Poland and technical requirements it has to fulfil. The second section provides an overview of the existing electronic student identity card management systems in Poland. The electronic student identity card management system that has been developed and designed at Poznań University of Technology is presented in the third section. The forth section contains a summary, conclusions drawn from the implementation of the electronic student identity card management system and its further development potential.

Electronic Student Identity Card

On July 18th, 2005 the Ministry of National Education and Sport announced a new regulation on the documentation of the student academic record that also modified the eligible form of a student identity card. Two eligible forms of the document were introduced: a paper card with a new graphic design and an electronic one (Electronic Student Identity Card, in short ELS that stands for Polish "Elektroniczna Legitymacja Studencka"). The regulation also introduced new application of the electronic student identity card as: public transportation ticket, university access control system identifier and library card. It also became possible to use the card for purposes not related directly to a given university and the fact of being a student itself, for example, as a loyalty card.

Work on the regulation was driven by the necessity to enhance the credibility of the student identity card as a document certifying the student status. This function was achieved by introducing the electronic form of the student identity card distinguished by unique student's identity data format and signed by a secure electronic signature verified by a valid qualified certificate. This approach required the update of the Student Information System and at some universities the necessity arose to implement such system.

In Poland, it is the responsibility of the university to issue cards and deliver them to students. The student identity card certifies the status of being a student and authorizes the user to buy a half-price public transportation ticket. It also allows to use certain local privileges. Students can use the identity card since receiving it until graduation, suspension or deletion. If any of these occurred the student has to return the card to the university. ELS is a document having a limited validity period. The validity of a card for a given period is confirmed by updating data in the electronic system and by a hologram sticker placed on the card.

Electronic card standardized dimensions are 85.6 mm x 53.98 mm and correspond to the ID-1 identification card in accordance with ISO/IEC 7810. The following student's personal details: full name, album number, national identity number, address and photo are printed on the card in the process of graphical personalization as well as information about the university which issued the card and the date of issue. ELS design is shown in Figure 1.

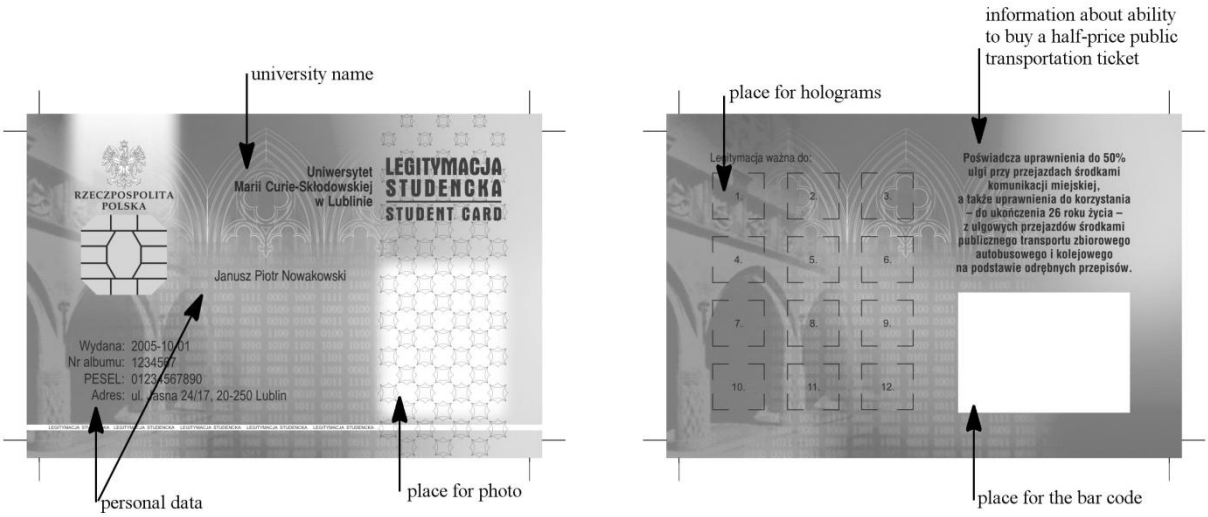

Figure 1 Design of the Electronic Student Identity Card

Electronic part of ELS card is a processor card with a contact interface specified in ISO/IEC 7816-2 and ISO/IEC 7816-3 standards. The card can also contain other interfaces, including a contactless interface. The data structure of the electronics of a student card is compliant with the fourth part of ISO/IEC 7816 standard. The structure and the content of files are precisely defined in the regulation mentioned above. ELS compulsorily compulsory contains the following files:

- DF.SELS – dedicated file of an application identifier registered in KRKI (the Polish national application provider) having value D6 16 00 00 30 with proprietary extension 01 01 as well as two filial files
- EF.CERT – elementary file of an identifier 00 01 that contains the qualified certificate of a person signing the data in EF.ELS file,
- EF.ELS – elementary file of an identifier 00 02 that contains a message signed with a qualified certificate. The message contains several vital data on the student who uses the card. It is specified in the appendix to the regulation in ASN.1 notation in the following way:

```
SELSInfo ::= SEQUENCE {
   wersja INTEGRER {v1(1) -- structure version}
   numerSeryjnyUkladu PrintableString (SIZE (8..16)),
   nazwaUczelni UTF8String (SIZE (1..128)),
   nazwiskoStudenta SEQUENCE OF UTF8String (SIZE (1..28)),
   imionaStudenta SEQUENCE OF UTF8String (SIZE (1..24)),
   numerAlbumu PrintableString (SIZE (1..16)),
   numerEdycji PrintableString (SIZE (1)),
   numerPesel PrintableString (SIZE (11)),
   dataWaznosci GeneralizedTime
}
```

All fields are described in details in the regulation. The file structure is shown in Figure 2.

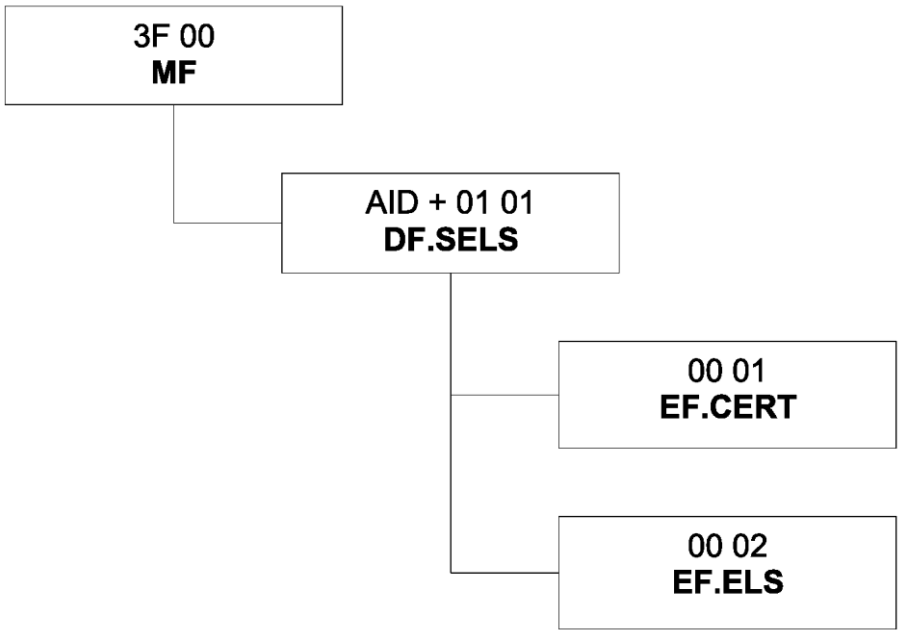

Figure 2 Structure of the Electronic Student Identity Card

Electronic Student Identity Card Management Systems in Poland

There are two main organizational approaches to the management of the student identity card systems in Poland depending on the development of a student card personalization centre serving students. Namely, a single centre may serve the university, where it is located only or more than one institution.

The applied technology depends on the chosen solution.

Polish universities successfully use both types of systems. The biggest, but not the only one, systems are the following ones:

- University Student Information System (USOS) with electronic student identity card service module,
- OPTIcamp – electronic student identity card management system extended by other academic services,
- electronic student identity card management system used at the Inter-University Personalization Centre of Electronic Student Identity Card at the Poznań University of Technology.

The University Student Information System USOS [1] has been developed by the Inter-University Centre for Information Technology [2]. The system primary task is to manage comprehensively student academic records for undergraduate, graduate and PhD students as well as academics staff data. A characteristic feature of this system is a central database and modularity of its elements. The functionality of managing ELS is a part of the students academic record module and supports personalization, signing and validity extension of the ELS, maintaining the registers associated with ELS, like blankets, holograms and certificates, issued ELS, etc. Obtaining the necessary data for personalization, including photos, is implemented as a function of USOS. The electronic student identity card management module supports cards produced by UNICARD, Gemalto, Oberthur, as well as plastic card printers produced by: Fargo and Evolis. An identity card managed by this module can also serve as the library card and, in some cities, as a city card. It can also be used for identification in access control systems.

OPTIcamp is a similar solution to the one shown above, but it has been designed by a commercial firm. It is also a modular system. The electronic student identity card management system was created by OPTIcamp as an extension to the financial system, human resources management system and the Student Information System. It allows personalization as well as issues electronic student identity cards and extends their validity. It consists of a number of elements that organize the management of multiple subsystems and services: from those associated with basic ELS management, like collecting and accounting various fees to those connected to using ELS in the library and reading room. The OPTICamp software is used by many smaller universities. This software also provides the basis for personalization centres created jointly by universities. The personalization centre is located at Wroclaw University of Technology and serves ten public universities.

Another personalization centre, created for several universities, is the Inter-University Personalization Centre of Electronic Student Identity Card at the Poznań University of Technology (in short MCPLS from the Polish language "Międzyuczelniane Centrum Personalizacji Legitymacji Studenckiej") [3]. It serves 15 universities, mainly from the region of Wielkopolska. Electronic student identity card management system (in short SELS PP from the Polish language "System Elektronicznej Legitymacji Studenckiej Politechniki Poznańskiej") is a stand-alone system for the card lifecycle management, interchanging information and data with the Student Information Systems. In addition to a basic functionality associated with personalization, extension of validity and keeping the necessary records, SELS PP also allows the management of additional applications associated with the card, e.g. public transportation tickets, library card, and identification in the access control system. SELS PP can also provide an active data exchange with the application issuer using given infrastructure [4].

Obviously, the solutions presented above have some advantages and disadvantages. The option based on a personalization centre shared by several universities seems to be economically justified. The entire infrastructure associated with the process of issuing cards concentrates in one place. The costs of specialized hardware and software, the maintenance costs of adequate space and conditions for personalization, maintenance of specialized personnel, operating and equipment amortization, maintenance of infrastructure are shared by several users. The challenge is, however, the

implementation of dedicated software supporting the student identity card system that can not exchange data with any other student information system used at the cooperating universities. Organization and logistic of the student identity card management system can be also problematic. An example of a comprehensive solution is SELS PP used in MCPLS, hence described later in the paper.

Electronic Student Identity Card Management System of Poznań University of Technology

SELS PP is an original solution developed by Poznań University of Technology and implemented at 15 universities. SELS PP is a distributed system. Each university has its own hardware and software (local SELS, ISELS) operating on the data of this University. The central part of the system is the Inter-University Centre for Personalization (MCP) with the relevant software modules, specialized plastic card printers and service enabling personalization of ELS in accordance with the imposed requirements. Information used for personalization is obtained automatically from the Student Information System used by the relevant university. The data produced during the personalization process can be transferred back into the Student Information System. Universities that do not choose to use existing systems as data sources have the opportunity to introduce data manually. It should be noticed that the extension of validity of the card is executed by the Terminal SELS.

System requirements

The solution proposed by the Poznań University of Technology is based on the assumption that the electronic student identity card management system is a system separated from the Student Information System of a given university. This assumption was justified by the variety of systems used by the universities served during the project by the personalization centre. In addition it was impossible to make any changes in those systems, and, finally special safety rules had to be observed during the process of issuing the electronic student identity cards. Thus, the system should be

implemented taking into account different levels of computerization of particular universities. The basic idea was to combine the minimum inference in the existing student information system and fully integrate the ELS and SIS at the data exchange level.

It was assumed that the system should be prepared to manage both: the card as a carrier (card life cycle), and the card as an application. It should also independently manage individual applications together with their characteristic life cycle (application life cycle). The system should also take into account any relations between the state of a card and the state of an application. With such set of assumptions the electronic student identity card is understood as a specific, but one of many, application that can be placed on the card [5]. These assumptions cause, that the system is designed as a dedicated card management system (CMS) – tailored to the needs of management of the electronic student identity card.

Other assumptions relate to the data source. It was assumed that the only data source is the local university Student Information System and communication between SIS and SELS should be initiated only by the latter one. The system should also be resistant to communication breaks.

System architecture

SELS PP is a distributed system. Its purpose is to provide resources of the Inter-University Personalization Centre for the purpose of personalization of the electronic student identity cards. The system architecture is shown in Figure 3.

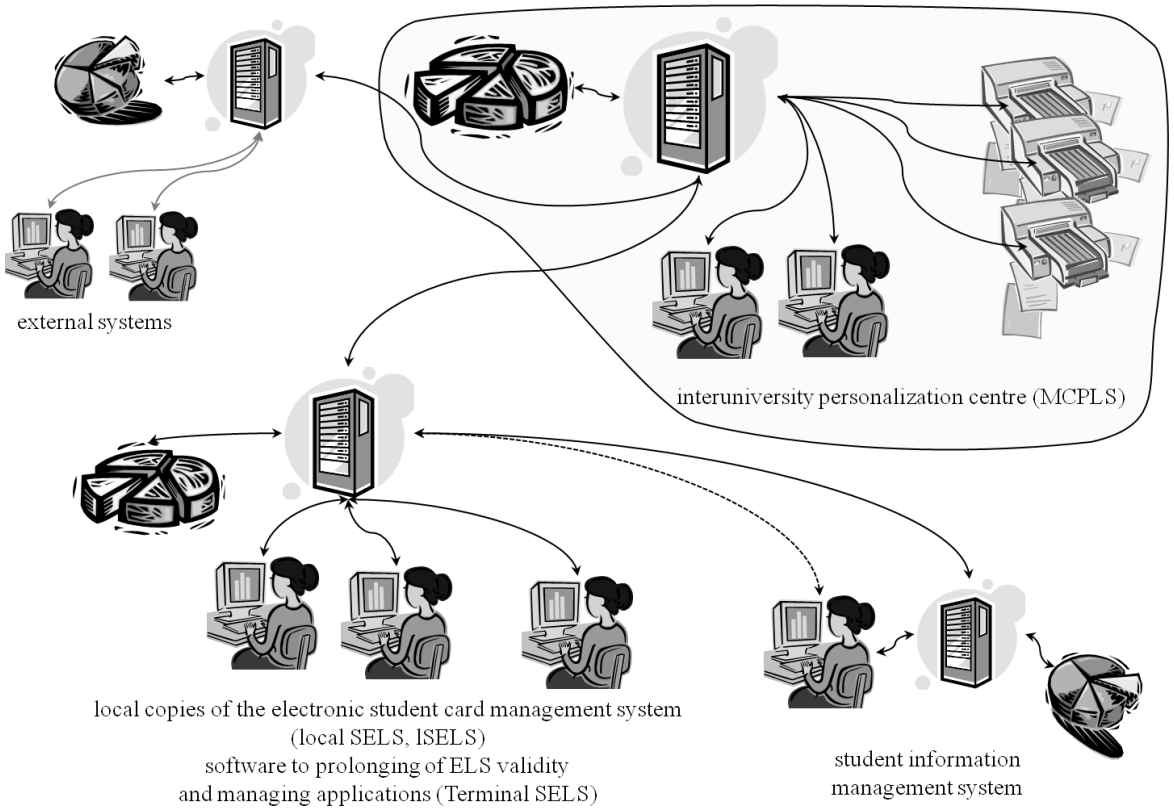

Figure 3 Architecture of the Electronic Student Identity Card Management System

Two main elements of the SELS PP can be distinguished:

- interuniversity personalization centre (MCPLS),
- local copies of the electronic student card management system (local SELS, lSELS).

Moreover, the system includes:

- software for extension of the ELS validity and for managing applications (Terminal SELS),
- a module for data exchange with external systems.

The personalization centre uses a central database containing data of all university students using the services. A local copy of the system at a university, uses a database containing only data of student from that university. This allows to use the local systems regardless even in the case of long-term communication interruption between the local system and the personalization centre. Should this

happen only the incomplete personalization orders and some operations related to installation of new applications are not available. Another copy of the data fragment contains a database used by the module for the exchange of data with external systems. These data are limited to a subset required for running an external system.

Data are sent in an encrypted communication channels between the personalization centre and local fragments. The main interface used is the Web browser that allows both: the personalization centre and the Student information System to access the student identity card management system.

The functionality of the system

The elements described in the previous section perform different functions. The personalization centre module implements its functionality including data exchange between the universities, the execution of orders by grouping the cards in card batches, graphical personalization, electronic personalization according to a specific profile, provides mechanisms to verify the correctness of personalization, the management of: blankets, transport keys, applications, users and their privileges, certificates and handling of the transportation procedures.

The local copies of the electronic student card management system perform functions necessary to obtain student data, handle personalization orders and transportation procedures and support the life cycle of the student identity card in the future stages.

Other modules perform functions necessary to the realization of tasks assigned to them.

Personalization centre

A standard for data exchange covering the minimum set of data necessary to personalize the card has been defined in order to exchange data between the electronic student identity card management system and the university student information systems. The data exchange can be based on the views

defined in the university's database. It can be also performed in SELS PP data exchange services (WebServices). Using the latter services also enables the full integration with the university information system. It is also possible to input the data necessary for personalization of a card manually. Data exchange can be unidirectional – in case where the information used to personalize the card are transmitted to the SELS, or bidirectional – in case where information about the personalized card are transferred to the university system. The minimal set of data necessary for personalization of a card is shown in Table 1.

Name	Type	Purpose	Note
name1	varchar(24)	first name	not null
name2	varchar(24)	second name	
name3	varchar(24)	third name	
surname_l1	varchar(28)	surname – first line	not null
surname_l2	varchar(28)	surname – second line	
address_l1	varchar(40)	address – first line	not null
address_l2	varchar(40)	address – second line	not null
national id number	varchar(11)	national identity number	not null
student_number	varchar(16)	student number	not null, unique
photo	blob	photo	not null, binary data
tags	varchar(2000)	additional parameters	optional

Table 1 Minimal set of data exchange

Methods and types supported by the WebServices are shown in Table 2.

Method name
getStudentsData
putCardsData
putApplications
Type name
Student
Students
Card
DictionaryItem
Key
Status
Application

Table 2 Methods and types supported by WebServices

An important task of the personalization centre is to handle the specialized printers dedicated to smart card personalization. Each printer has to be supported by a separate computer workstation. For that reason a control module has been designed that collects and executes commands received from the central location (picture).

This solution makes it easier to control the personalization process and balance the load of particular printers. It also allows for the parallel work of several operators without blocking the workstation during, for example, the preparation of data for printing. With this solution any extension of the existing hardware is very simple because launching another printer does not require increasing the number of workstations. The need for additional communication between the various elements of the system may be considered a disadvantage since it may decrease the system efficiency. In practice, however,– the communication delay is negligible from the perspective of the operator.

The personalization module allows for creating and sending the graphical image of the student identity card to the printer. The cards have a fixed pattern and the offset overlay is required for the background of the card. Thus, the image developed during the personalization process contains mainly personal data and the photo of the student. Since the regulation allows for placing the bar code on the reverse side of the card, the personalization module allows to create a barcode image of the library identifier assigned to the student. The module also handles some of the errors that are specific to printing devices, which do not cause damage to the card allowing completion of the interrupted single card personalization.

The same unit is also responsible for electronic personalization process during which additional applications are assigned to the card. In the simplest case it consists of reading the card number. In more complicated cases the separate applications intended for the card's operating system, such as JavaCard, are installed. Like in the process of graphical personalization the module also allows for handling of errors specific to smart card readers and the cards themselves.

During the process of electronic personalization it is necessary to add an electronic signature verified by a valid qualified certificate owned by a person authorized to extend the validity of the student identity card. An additional module working with software that supports the electronic signature is responsible for that task.

The software of the personalization centre supports electronic signature issued by all Polish qualified centres, while currently two of them are certified in system. The software supports FARGO printers,

series HDP600 and HDP5000 and smart cards produced by Gemalto and Oberthur. The elements supported by system are shown in Figure 4.

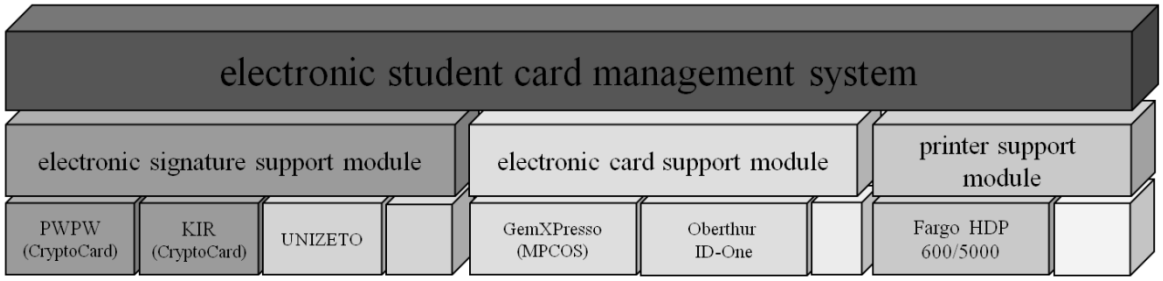

Figure 4 Elements supported by system

The personalization orders brought to the centre are grouped in batches of maximum 100 cards. Orders from one university only may be found in a single batch. A request to personalize a card batch is sent to the printer. A confirmation code is generated for each batch. The code is printed in the bill of lading, next to the card list. After receiving the cards from the personalization centre by an authorized person, the batch is marked as "sent to the university". Reaching the destination is confirmed in the system with the code printed earlier in the bill of lading. A card can be then handed to a student and further handled only after the final confirmation.

ISELS

The university manages the process of ordering the card personalization in three stages.

During the first stage the data on all students who are supposed to have a student card is collected. The import of the data is a task that runs in the background. At this stage the system communicates with the Student Information System and downloads all information required for preparing a student card. If the university does not have the information system, the data is inputted: directly to the system, or from a file of a given format.

During the second stage the data is verified. If the data is incomplete, e.g. there is no photo included or it has got a wrong format, the user is informed accordingly. Pursuant to one of assumptions of the system, it does not offer the possibility of correcting the data. The universities that input data manually

are here the exception. If the student's data is complete and follows a right format, then it is compared with the data stored in the SELS database. Based on the comparison, the user can choose one of the following actions: add, change or delete student's data from the SELS database. When the user chooses to add or change the data, a relevant order for the personalization centre is created. The user can also change the data in SELS without the need for the personalization of a student card. This last functionality has been dictated by the frequent introduction of minor corrections by university staff to student's data, as a matter of fact corrections irrelevant to the data itself e.g. a change of address format from 23/3 to 23 f. 3. At the stage the user can modify a basic set of applications for student cards. The second stage ends with the preparation of a list of orders for the personalization centre. During the verification of data and creation of orders the user is able to view student's data.
Should these figures have changed, the system marks the modified information making them readable to the user.
The third stage is to approve a previously prepared list of orders. This stage starts in the background the process of communication between the local copy of SELS and the personalization centre. The orders are sent individually. The start of personalizing is therefore possible after sending the first order from the list.

In addition to processing the orders, the system allows the user to manage the data in the SELS database. Displaying the student data both current and historical is optional. The system also allows for displaying the information about cards that have been issued to a student so far, including all information related to: student's data on the card, card details and personalization process as well as data stored on the electronic part of the card. A complete history of the card state is also available. The system enables the user to change the card state (e.g. blocking the card after receiving the information about loss or theft) and to order the personalization of a duplicate.

Local SELS also performs functions related to the transport procedure – in this case, the system requires a code from the bill of lading certifying that the batch of student cards reached the destination.

SELS terminal

Another highlighted feature of the system is software that extends the ELS and manages applications. The SELS terminal is intended primarily for university staff who extend the validity of student cards. The software allows the user to read the data on the card located in the reader directly from it or from the local SELS system, manage the cards through changing the status of a card or applications, and especially extend the validity of the electronic student identity card. It is possible to extend individual student cards or card series. In this regard, the software performs the function of an electronic signature. It is possible to install and remove additional applications using the SELS terminal. The SELS terminal is software that updates automatically. It allows fast introduction of new applications for the card.

New applications for existing cards can also be installed and updated automatically. Such action may be performed "by chance" when the validity of the student card is being extended. The delay in installing new applications or newer versions for all active student cards in circulation will not amount to more than half a year.

The terminal also has additional features, which are the following: the possibility of authentication via a user certificate and the possibility of registering the user certificates by the local SELS administrator.

Functionality of the module for data exchange with external systems

SELS enables the user to exchange data with applications issuers systems. For this purpose, similarly to the exchange of information about students, the format of data exchange has been identified. The same mechanism is also used by entities that do not issue applications, but use the information on the card in order to automate certain processes. The reading room of one of the universities provides an example where some components of the access control system have been installed. Students using the resources of the reading room are not required to register prior to their entrance. Required information - in this case the university - are read from the SELS using the module for data exchange. There have also been developed modules for application data presentation dedicated to application issuers who

have not decided to integrate with the SELS system. The functionality of these modules is limited to retrieving and presenting a given subset of the data.

Common functionality of different modules

Both the personalization centre and the local SELS allows the user to generate various reports. Some mechanisms that enable administrators to create templates of reports based on SQL queries to databases have been implemented in the system. Based on these templates, the user can generate the required statements. The system includes several templates. Depending on their definition, the reports can be run in the personalization centre, in the local SELS, or both.

In both parts of the software have also been implemented administrative mechanisms – defining users and their entitlements, registration of certificates, etc. It should be noted that certain sensitive operations, such as the actions related to organizational units, adding a user or a certificate, executed on the local SELS require confirmation by the chief administrator of the system.

Applications managed by the system

SELS has been designed to allow the management of a card. In this regard there have been implemented the card state management consistent with GlobalPlatform. It also includes support for other card state management, such as the native operating systems of the card. Due to the specific ELS solution imposed on the one hand by the legislator in the form of defining a graphic design and data structure as well as the necessity of personalization in one course and on the other hand by the supplier of blank forms in the system, the number of card states have been broadened. The states have also been connected with the basic application – the electronic student identity card.

The system allows the user to manage applications independently of the carrier. "An application" may be understood as each element that is subject to personalization, but not only. There may be elements of personalization, such as background, personal details including a photograph, bar code. These may

be the data recorded in the electronics system or electronic systems using any of the card communication interfaces. Finally, the application can be the data exchanged with other systems, which use any part of the card. These figures are kept neither in the graphics layer nor in an electronic memory card. The SELS can manage the following applications:

- electronic student identity card,
- library card,
- access card to the reading room of University of Physical Education in Poznań
- carrier of Poznań e-ticket,
- carrier of Warsaw city card,
- identifier in the access control system of Poznań University of Technology,
- identifier in the access control system of Poznań University of Medical Science,
- carrier of common certificates.

The system provides the ability to manage other applications, including:

- e-wallet,
- loyalty card.

The set of possible applications managed by the system is open. In practice, adding any application is optional.

The basic requirement for SELS is to handle the card as the electronic student identity card. The application of electronic student identity card consists of the following elements:

- information about the university issuing the card,
- student's personal details, including a photograph,
- files described in section ... placed in the memory card.

The life cycle of the card is linked to the card and its basic application. It begins when the personalization order appears. Next states identify the stages of personalization, transport procedure,

events occurring in the course of using the student card until it is withdrawn from circulation. The life cycle of the card is shown in Figure 5.

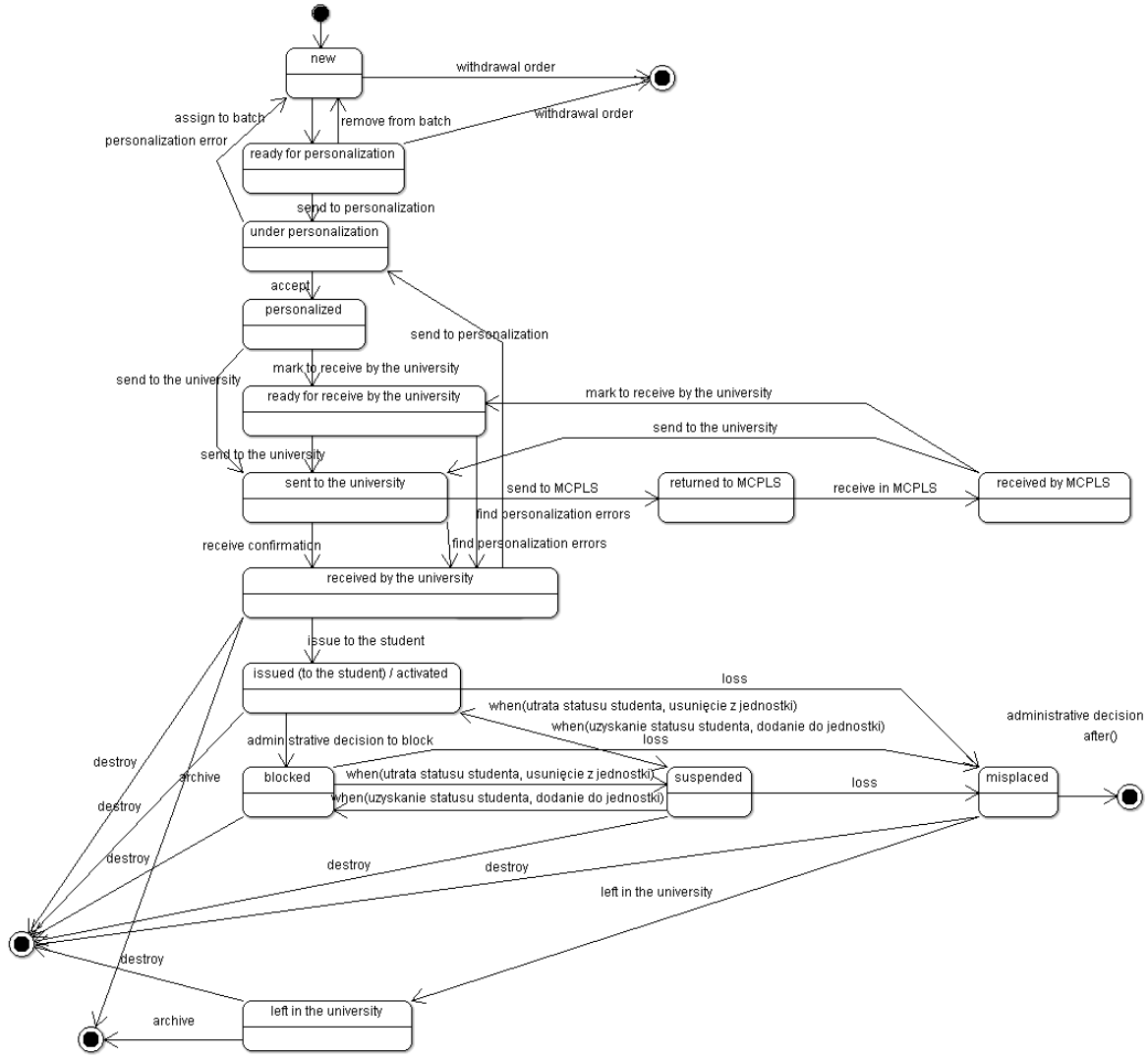

Figure 5 ELS life cycle

Presented states of the card allow accurate defining what has happened with a given student card during each stage of its life cycle. It is important material which allows the confirmation, if in doubt, of the status of being a student by its holder.

Library card

SELS includes the library application in three versions: basic, file-based – ELIB [6] and JavaCard application – jELIB [7] The basic application library consists of a unique identifier assigned by the Poznań Foundation of Scientific Libraries. It is applied as a bar code at a designated place on the reverse side of the card. Electronic versions include an application identifier registered in the KRKI in accordance with ISO / IEC 7816-5. ELIB is a defined file structure made available to and handled by the reader service system. jELIB is a collection of its own APDU commands and responses and it facilitates operating within ELIB file structure.

Access card to the reading room of Physical Education Academy in Poznań

The related application – due to the area of implementation – is the access card to the reading room of the Academy of Physical Education in Poznań. There are automatic gates that enable holders of a such card to enter the reading room of the Academy of Physical Education in Poznań. The reading room statutory provides a limited registration of readers. The card application reads the serial number of a given card and a conventional university identifier, and then provides the information to the registration system of the reading room. Due to the cyclical synchronization of the data, users of active cards are guaranteed the admission to the reading room without the registration process.

Carrier of Poznań e-ticket

The electronic student identity card in Poznań is the carrier of an electronic ticket - KOMKarta. This feature has been launched in conjunction with the Management Board of Municipal Transport in Poznań (the ZTM), based on the contactless interface in the industry standard Mifare. The personalization process consists of two stages. At the first stage a previously prepared set of data agreed with the ZTM is recorded in designated sector Mifare memory. During the second stage, using the equipment supplied by the ZTM system operator, the data structure is finally prepared and the Mifare memory is secured with keys appropriate to the ZTM system. Due to this solution, a compromise has been reached that enables to keep the details of the solutions used by ZTM

confidential and ensures the fine quality of personalization process as well as its compliance with regulatory requirements through the preparation of a student card in one place. The application support is divided between the SELS system and the ZTM system. SELS is responsible for preparing the appropriate data structure. It also transfers, upon request, the information about the user of a carrier who registers in the ZTM system. The ZTM is responsible for all activities related to municipal functions, including in particular public transport ticket sales.

The developed solution is unique in the country. In other cities or urban agglomerations the city application – city card or public transport ticket – is personalized in two stages in two different locations. At the first stage the operator of the municipal system carries out activities related to the personalization of the city application. During the second stage, after the blank forms are transported to the university personalization centre, the electronic student identity card is being personalized.

Carrier of Warsaw city card

At the request of one of the universities benefiting from the SELS system the aforementioned two-stage municipal application personalization process has been implemented in Warsaw. In this particular case, it involves reading the Mifare serial number and a numeric code affixed at a designated place on the electronic student identity card. SELS makes further attempts to read the Mifare memory with transport keys appropriate for a given batch of blank forms. If the reading is successful this means that the pre-personalization process carried out by a city application operator has failed and it signals this fact to the personalization centre.

Identifier in the access control system of Poznań University of Technology

Poznań University of Technology has provided its students with an opportunity to use parking places located on its premises. The entitlement is exercised under a serial card number available through the contactless interface. SELS exchanges the data in this area with the access control system allowing the user to automate the process of entitlement management and registration.

Identifier in the access control system of Poznań University of Medical Science

A similar application is the identifier in the access control system at the University of Medical Sciences in Poznań. The difference is that in the Mifare memory some data is additionally recorded and keys specific for the system set.

Carrier of common certificates

ELS is used as a secure carrier of certificates, what allows the user to benefit from the services offered by public key infrastructure (PKI). The PKI application initiates a data structure corresponding to the file system and defines the entitlements and the initial PIN and PUK codes of a cardholder. The values of these codes are sent to the local SELS and used according to the policy adopted by a given university.

During the personalization process, in cooperation with the university CA, the pair of keys is generated for students of Poznań University of Technology, and then a certificate is placed on the card. After receiving the card and obtaining the pin number from the University Student Information System, students can immediately use the certificate for identification and authentication when logging onto computers in the laboratories, identification and authentication in a wireless network, or even for signing emails.

Implementation of the system

SELS has been carried out mainly based on free of charge solutions provided along with the source code. However, not in all cases the rule has been kept. For the modules that implement cryptographic functions and manage the printers it is more economic to use finished commercial solutions than to create from scratch own one.

The data necessary for the operation of the system are stored in the object-relational PostgreSQL database. The personalization centre and local copies of SELS have been built on the Apache HTTP Server with PHP programming language. The same technology has been used in the modules for data exchange with external systems. Database servers and WWW work on devices managed by the Linux Slackware operating system.

Printer control software, software for signing, extension of ELS and management of applications (Terminal SELS) have been developed based on. NET framework. The module also benefits from SecureBlackbox libraries produced by Elbos. Printer control software also uses a programming environment designed for Fargo printers – Fargo Software Development Kit, and the positions that require electronic signatures need the software that supports the card that is a carrier of the certificate (PKCS#11 libraries).

Update of system components after appearing their new versions is a fundamental principle. If the changes that are being implemented require the source code update, such update is performed.

Plug ins

All modules have been developed based on the philosophy of plug-ins. Similar functionality has been developed for handling the applications. Such approach tailors the personalization centre software and the local copies of SELS exactly to the needs of a given university. The university system, where a particular application is not used, does not execute instructions for it. In simpler cases, support for the new application can be determined directly by the system administrator.

Examples of screens

Some screenshots of selected elements are presented below. Considering the fact that the software is dedicated solely for the user speaking the Polish language the content of screenshots has not been translated. Figure 6 shows the personalization centre module. A web page shows a drawing of a printer

being currently used. The background colour indicates its status, and so: green – normal operation, yellow – warning, red – error. Details of operation currently being performed are described for each printer below, such as e.g. coding the contact part, deposition of printing, laminating. Displaying the obverse and reverse of a card being currently personalized is optional. Information about the card serial numbers read by the card interfaces are also available. Information about the batches of cards assigned to a given printer is presented in the further part of the paper. Operations associated with removal from the queue or moving the batches of cards within the queue as well as assigning a new batch of cards to a particular printer are also possible. The printer control module is operated using the buttons on the bottom of the panel dedicated to a single printer, including starting and stopping the process of personalization on a given printer. By using the software SDK Fargo a given printer can be directly controlled e.g. the confirmation of printer warnings is also possible.

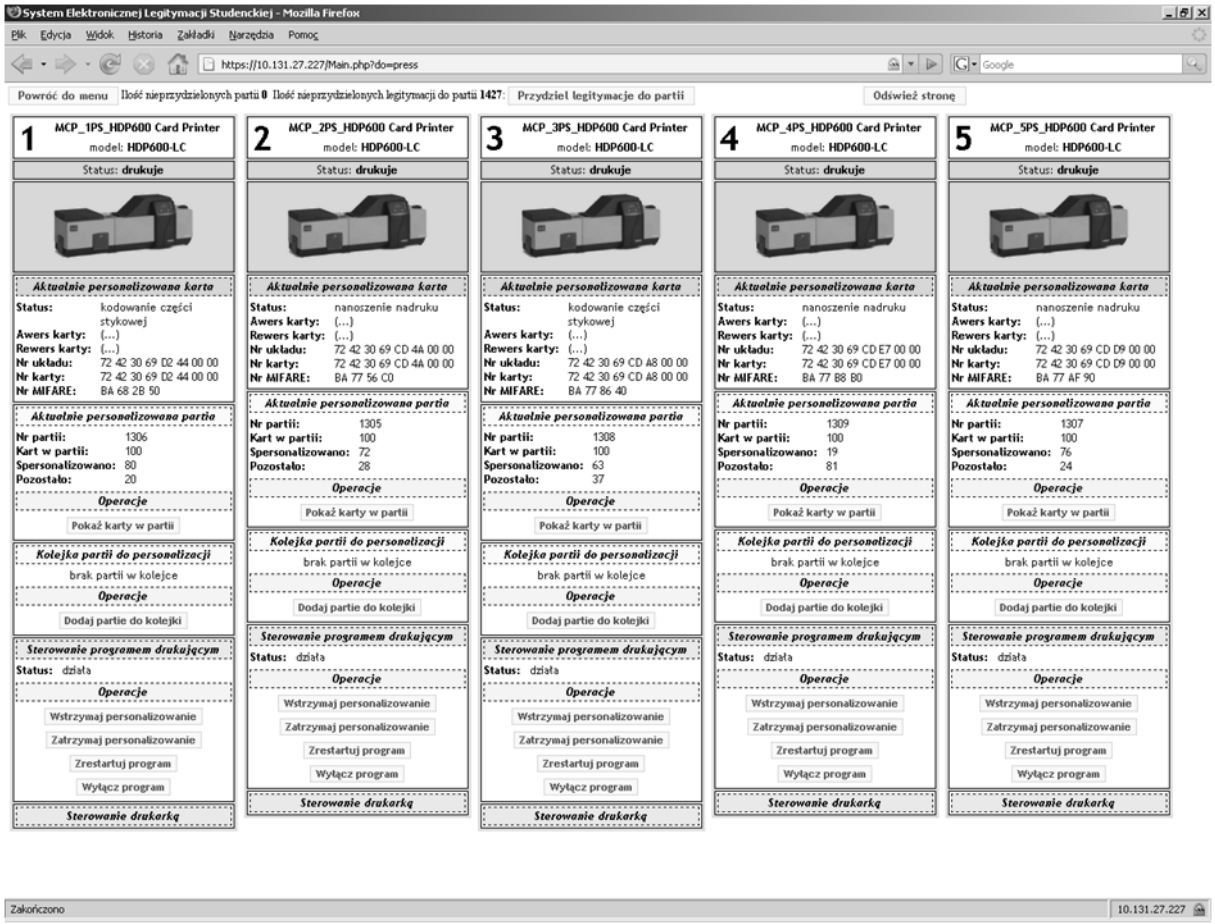

Figure 6 The personalization centre – printer control module

Figure 7 provides the card design and the personalization state of a card. Local SELS interface has been further enhanced and have the ability to present details of the card, student's data stored on the card, current card state and history of card states. The user of the system can also change the card state, request a duplicate print or another card.

Figure 7 ELS shown in the system

Orders, batches, or student's data are presented to users also in the form of a list. A sample list of students is shown on Figure 8

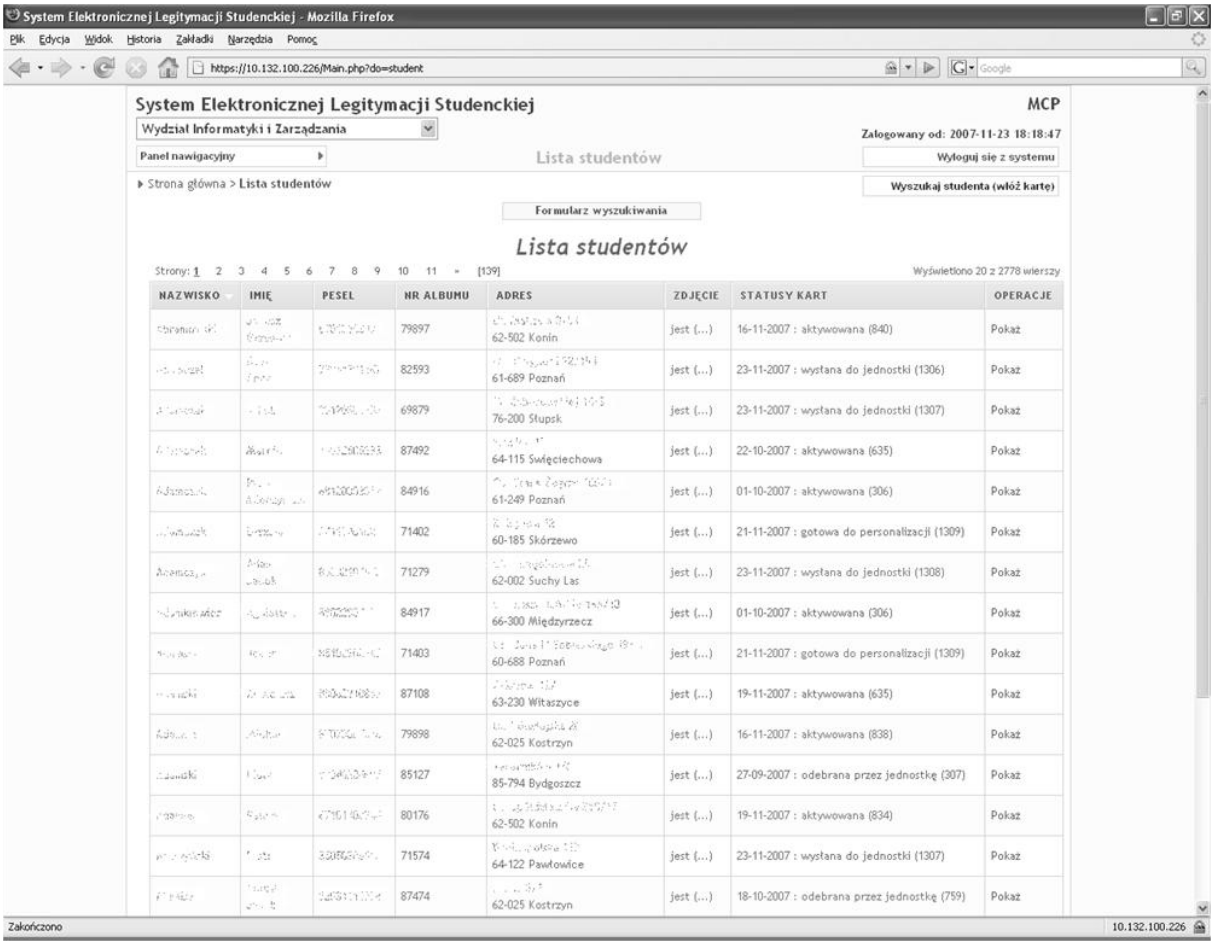

Figure 8 Sample list of students

Extension of ELS validity is performed by the dedicated software that is a stand-alone application. Figure 9 presents the application window showing the student data read directly from the electronic student identity card.

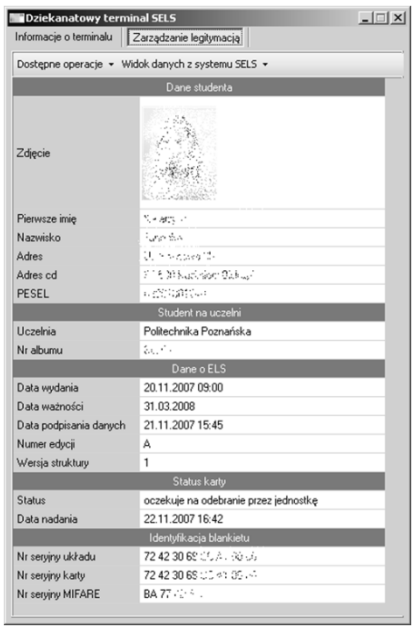

Figure 9 Data read from the electronic part of ELS (Terminal SELS)

Personalization

The personalization process has been divided into parts related to applications. The personalization process is started by personalization of the electronic part accessible by the contact interface. If the card mechanisms allow the user to access some part of the memory available via the contactless interface with the use of the contact interface (e.g. Oberthur ID One card) then a simultaneous programming of such memory card occurs. The next stage is to program through contactless interface. Successful completion of the programming will start the graphical personalization, followed by the stage of securing the card with foil lamination. Eventually, the card is verified by an employee of the personalization centre. The method of personalization and data that are stored on the card during the personalization process are the sum of the requirements imposed by all card applications.

Qualified electronic signature service

SELS is prepared to make an electronic signature using the private key stored on the cryptographic card. Currently the system is registering the certificates issued by Sigillum PCCE and KIR SA. In both cases, the keys and certificates are stored on the CryptoCard multiSIGN cards.

Personalization equipment

SELS has implemented dye-sublimation photo printers Fargo HDP600 and Fargo HDP5000 furnished with a module for programming smart cards, equipped with the contact and contactless interfaces as well as a laminating module. At the centre's disposal there are also dye-sublimation photo printers Evolis Dualys and Fargo DTC525. However, due to the higher quality offered by the retransfer printers, the latter group is decided not to be used on the regular basis.

Supported smartcards

SELS is designed to accommodate a wide range of cards that meet the requirements of the regulation. Currently, the system supports cards produced by Gemalto – GemXPresso Pro R3.2 and Oberthur – IDOne.

Universities and funding

The Inter-University Personalization Centre of Electronic Student Identity Card was created as an organizational unit of Poznań University of Technology in agreement with seven universities (ordering by the number of students): Adam Mickiewicz University in Poznań, Poznań University of Technology, Poznań University of Economics, Poznań University of Life Science, Poznań University of Medical Science, Eugeniusz Piasecki University of Physical Education in Poznań and Ignacy J. Paderewski Music Academy in Poznań. These institutions maintain the personalization centre by an annual contribution. Part of the contribution, which covers the costs of ongoing centre maintenance (maintenance costs of work areas, cost of work, etc.) is shared in proportion to the number of students of a given university. Other part results from the allocation of costs by the actual number of personalized cards (the cost of supplies, equipment depreciation rate, etc.).

8 higher education institutions that did not participate in the creation of the personalization centre (in alphabetical order) can also use the services provided by it: Gniezno School of Humanism and Management - Millennium, State Vocational College in Gniezno, Stanisław Wojciechowski State Vocational College in Kalisz, Poznań Trade and Commerce College, Poznań College of Modern Languages, College of Education and Administration in Poznań, Poznań College of Management and Banking and Vocational Higher School of Cherishing of Health and Beauty in Poznań. The Inter-University Personalization Centre of Electronic Student Identity Card provides to these institutions ELS personalization services on the basis of appropriate agreements. Income earned in this way diminish the part of contribution made by the founding universities – and it partially covers ongoing maintenance costs.

The sum obtained under license agreements are an additional income for the personalization centre. Software license is also granted to the Higher School of Pedagogy of the Society of Public Knowledge in Warsaw.

Summary

After almost 5 years since implementing, SELS PP is a mature lifecycle electronic student identity card management system. Co-operation between the student information systems of different universities has been strengthening. The Inter-University Personalization Centre of Electronic Student Identity Card expands the area of its operation adding to SELS another higher education institutions. The centre also establishes cooperation with other issuers of applications and adds the ability to manage them.

The presented system architecture and applied solutions make it competitive in comparison to other electronic student identity card management systems. Implementation of the system in a formula that supports the personalization centres of many higher education institutions allows for a large reduction in necessary unit costs incurred when the centre is being launched. Inviting another higher education institutions to the system allows for further reduction of costs related to maintaining the centre, and it is the only economically justifiable option for smaller institutions. Launching the cooperation with

higher education institutions is very simple mainly due to separating SELS form other systems of a given institution and it does not constitute any barrier when it comes to choosing this solution. System design allows the user to calibrate it easily. Little effort is required to apply it to the city card and urban agglomeration card management. After the certification process it can also be used to handle the national identifier system.

Although the system is mature, works on its improvement are being continued. For the system expands its operational field by attaching next higher education institutions, it is decided to review and optimize the source code. At the same time there are being carried out works on the system ergonomics. The functionality is also being developed according to the needs reported by users e.g. reports. The possibility of using new products in the market, both in terms of electronic cards, printers as well as certificates is also being recognized and mechanisms supporting next applications are being developed. There is also a plan to migrate the employee card system of Poznań University of Technology to the system based on SELS architecture. As further consideration should be taken the task of developing the mechanisms for automatic load balancing in the process of printer personalization.

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