The Adoption of a Smart Card at the University of Porto

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1.   ABSTRACT

The University of Porto, recognizing the relevance of Information and Communication Technologies (ICT) for the overall performance of the institution, is committed to technology leadership for the benefit of the academic community. The Digital University Department is a central department dedicated to ICT, whose mission is to promote and extend the use of ICT to all the activities of the University, as well as to induce the development and adoption of innovative services in this area.

In this context and following a recent partnership celebrated in July 2008 between the University and the Santander Totta Bank, the Digital University Department is supporting the adoption of a university identification card – U.PORTO Card. It is a smart card with several embedded technologies allowing the implementation of a campus card system. Although this project is still in the beginning, significant improvements have already been achieved.

The main objective of this work is to present the project of the U.PORTO campus card. The goals, methodology, applications, adoption factors and ongoing developments are here discussed.

2.   INTRODUCTION

With its origins dating back to the eighteenth century, U.PORTO is Portugal's largest university in terms of student enrollment. About 30.000 students are currently registered in the approximately 600 study programs offered by the University.

U.PORTO today consists of fourteen faculties, about seventy R&D units, and several other autonomous services. The University premises are geographically spread in Porto city, although aggregated mainly in three areas.

These multiple locations, together with some other factors, support the strong autonomy of the U.PORTO faculties and the University's decentralized governance legacy.

Information and Communication Technologies are playing an important role in creating unity in diversity at U.PORTO (Katz & Dodds, 2009). An excellent example is the U.PORTO Information System for the Aggregated Management of Resources and Academic Records (SIGARRA) (Azevedo, Ribeiro, David, & dos Santos, 1997).

SIGARRA is an integrated information system developed to facilitate the production, storage, access, communication and dissemination of relevant information of all the U.PORTO activities, to favor internal cooperation and cooperation with external academic communities and companies, as well as to contribute to the cohesion of the community itself, encouraging good practices and compliance with procedures. The SIGARRA system, used to manage information at the U.PORTO, interacts with other applications and systems within the University, such as library and e-learning management systems. Currently the SIGARRA is used by all the faculties, as well as by the Rectorate, the Social Services of U.PORTO and some R&D entities.

Recognizing the relevance of ICT for the overall performance of the institution, the U.PORTO is strongly committed to technology leadership for the benefit of the academic community. ICT

governance is under the responsibility of a pro-rector, being also the director of the U.PORTO Digital University Department (DUD). This department is responsible, in particular, for the information management at U.PORTO and gives support and advice to the ICT offices or centres installed in faculties or other University units.

In spite of its decentralized model of governance and aiming at better supporting student mobility in the campus, as well as increasing the sharing of resources and the enhancement of services offered to the academy, U.PORTO adopted in 2008 a unique identification card for students and staff. In this context and subsequent to a partnership established between the U.PORTO and the Santander Totta Bank, the Digital University Department is supporting the adoption of the U.PORTO card. It is a smart card with several embedded technologies allowing the implementation of a campus card system.

Nowadays the U.PORTO card is in use not only for identification, but also for library loans, authentication in the printing/photocopying machines, staff control of presence, among other conveniences. Efforts have been made in order to extend the referred functionalities to all the faculties and the work already done gives us conditions to predict successful results in the near future.

3. PROJECT OBJECTIVES

3.1. Goals and objectives

The main goal of this project is to have a unique card for all needed campus applications. To achieve this goal, two main objectives were pursued:

- **Card emission**: ensuring that all academic community have access to the card;
- **Card promotion**: (i) the only identification card at the University; (ii) safeguard of the functionalities currently in use in the faculties; (iii) identification of a set of new key functionalities ensuring its implementation in all faculties; (iv) integration of new systems that may be adopted by the faculties; (v) maintenance of a support structure for the users.

3.2. Critical success factors

The most important factors identified to assure the success of the project were:

- Dissemination of the project;
- Decisions taken after hearing the government bodies of the faculties;
- Existence of policies allowing the use of the card;
- Cooperation with the stakeholders of the project;
- Study of systems/applications implemented using preexisting cards in the different faculties;
- Evaluation and implementation of added value applications for the academic community;
- Discussion with companies responsible for successfully implemented solutions at U.PORTO or other institutions.

During the project the success will be measured by:
- Number of users with U. PORTO card;
- Feedback from surveys to the faculties;
- Number of applications in use in different faculties supported by the U.PORTO card;
- Number of applications pioneered by the U.PORTO card.

3.3. Main threats

Some main threats to the success of the project were identified:
- Resistances in the intention of adoption;
- Lack of policies allowing the card to be used;
- Existence of other card solutions at some faculties;
- Inexistence of a support structure for the academic community.

4.   SCOPE

4.1. Organizational scope

Currently the scope of this project includes almost all U.PORTO organic units:

- Faculty of Architecture (FAUP);
- Faculty of Fine Arts (FBAUP);
- Faculty of Sciences (FCUP);
- Faculty of Nutrition and Food Science (FCNAUP);
- Faculty of Sport (FADEUP);
- Faculty of Law (FDUP);
- Faculty of Economics (FEP);
- Faculty of Engineering (FEUP);
- Faculty of Pharmacy (FFUP);
- Faculty of Arts (FLUP);
- Faculty of Medicine (FMUP);
- Faculty of Dental Medicine (FMDUP);
- Faculty of Psychology and Education Science (FPCEUP);
- Institute of Biomedical Sciences Abel Salazar (ICBAS);
- Rectorate (REIT);
- Social Services (SASUP).

In the future, the extension of this system to other units may be considered, for instance to include the University of Porto Business School.

4.2. Temporal scope

The project has a time span of 5 years. In the first academic year 2008/09, the new identification card should be available to all the members of the academic community and new functionalities should be supported in relation to the current ones.

5.   DEVELOPMENT

We may consider four different phases for the development of this project.

5.1. Acquiring expertise

This phase involved a thorough study of the technologies present on the U. PORTO card. This study was supported by the Santander Totta Bank, in particular providing technical expertise and documentation.

The U.PORTO card has several embedded technologies (magstripe, barcode, contact and contactless chip). At the beginning of the project the card was provided with independent chips (contact and contactless) but recently the U.PORTO card added value is the hybrid chip (dual interface) produced by Gemalto company. This chip - Optelio Contactless D32 R5 for Santander- includes Mifare capability (4K) and 32k EEPROM for applications/data with cryptographic capabilities. It's a Java card with several applets already embedded (e.g. Calypso V3, Classic IAS V3 - PKCS#11 PKI, PayPass M/Chip4, etc.) providing conditions for the development of several functionalities.

During this phase the University became a member of the European Campus Card Association (ECCA Website, 2010), aiming to obtain knowledge about the state of the art in the use of cards systems in higher education institutions. Despite there are no standards to implement a campus card system, the exchange of experiences allowed by the ECCA membership was very important for the development of the U.PORTO project, to reinforce within the academic community the value of such a system, in particular because of its ability to permit the offering of new services and by making student and staff mobility easier (Fridell & McKenna).

5.2. Card emission

Presently the Santander Bank issues cards for more than 200 universities in 13 different countries. The card issuance (Figure 1) is secured by a common global platform differing only in what respects to the customization, typically performed by a company located in the same country as the university. In the case of the U.PORTO the personalization was made by SIBS company (SIBS Website, 2010).
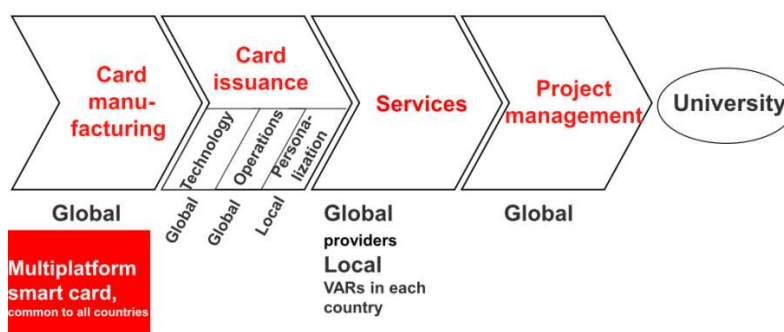

Figure 1 - Santander card issuance.

The card issuance involved two phases. The first one was the layout design for the U.PORTO card. This design was chosen by the University and conceived by a local designer. The identification of the card owner is assured by several items: photograph, name, U.PORTO identification number, category, and faculty affiliation (Figure 2).


Figure 2 - U.PORTO card layout.

After establishing the university card layout the issuing step follows.

The production of the cards implies the satisfaction of two main conditions:

- **"The University File"** that must follow a set of requirements and includes the necessary data for all the members of the academic community which may have the University card. To provide this file the U.PORTO developed a feature for the SIGARRA system that creates the file and sends it periodically to a secure FTP service of the SIBS company.

- A **"paper form"** to be completed by the user to acknowledge, verify and accept the usage of the data for the University card and also, if the user wishes, for requesting the additional bank component that the card may include. This form is sent to the company responsible for the card customization that crosses the data with the elements on the University file. If there are no errors, begins the production of the card.
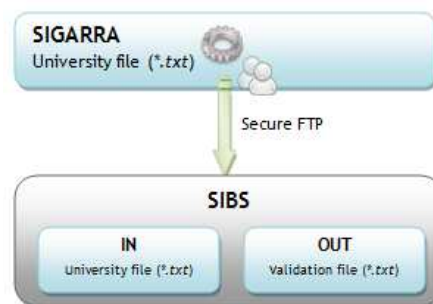
Figure 3 – U.PORTO card production: exchange of files

In addition, the success of the emission depends also on the policies adopted to deliver the card to the user. When the card has a bank component the responsibility of the deliver to the address given by each user belongs to the bank. If no bank component is included, the delivery is done by the University at each faculty.

5.3. Survey

When this project started it was known that many of the faculties offered differentiated services based on their own identity cards and in some cases even the local production of the cards, using distinct technologies.

In order to know better the functionalities used in the different faculties we launched a survey to identify the systems in use or under development. The data gathered allowed to observe several differences in functionalities implemented in the different faculties. As shown in Figure 4, access control (mainly car parking), printing and library loans were the most used.
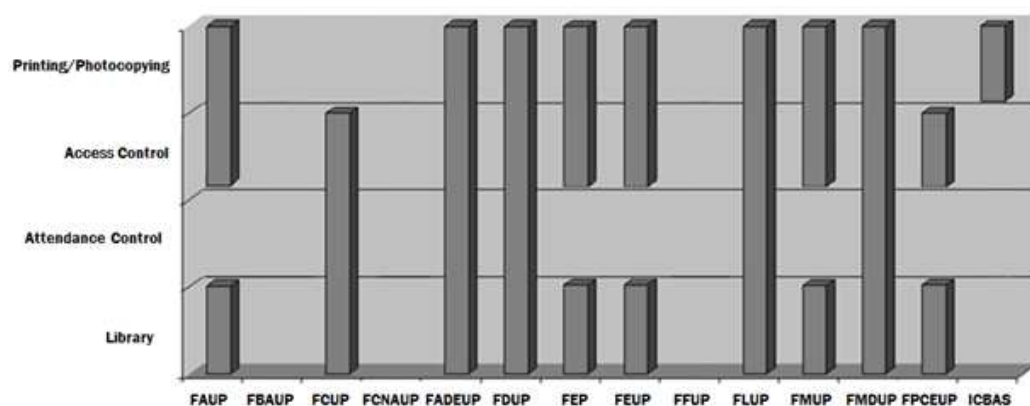
Figure 4 – Key features using a card: by faculty (year 2008)

However, despite the diversity of solutions/technologies implemented there were features relying mostly on a solution and/or company. These were the cases of attendance control (Millenio3) and printing control (Xerox).

5.4. Implementation plan

In the development of this plan our goal was to set up a procedure that minimizes possible resistances to the adoption of the card, so we offered the faculties the service of dealing with all aspects concerning the adaptation of the existing systems for the new card, if the faculties wished so.

This approach, although more complex since it obliged to work together with the different companies that had systems installed on the campus, was quite successful as it respected the

selection criteria adopted by each faculty, so minimizing resistance to change. For this adaptation two scenarios were analyzed:

- **Scenario 1 - Adaptation/Conversion of the systems currently in operation** (whenever possible there will be no conversion of technologies);
- **Scenario 2 - Adaptation/Conversion of existing technologies to more robust ones** (e.g. promote the use of MIFARE technology at the detriment of magnetic stripe);

The second scenario was considered the best for superior using of the card potential and also because of being sustained by existing research (Lee, Cheng, & Depickere, 2003) that backwards compatibility and relative advantage constructs are the major factors that influence the adoption process of smart cards.

After identifying the technical conditions and financial proposals for the adaptation/conversion of each feature, each faculty was informed and confirmed the interest in beginning the process. This consultation procedure and the financial support of the University to implement the change contributed strongly to the adhesion to the U.PORTO card.

In a second phase, U.PORTO intended to ensure access to the main functionalities allowed by the University card in all faculties and to implement new relevant ones. In all cases the integration of solutions with the information system SIGARRA was a primary request.

It is worth to emphasize that, regardless of the implementation of facilities mentioned, the new card allows reinforcing cohesion and strengthens the sense of belonging to the University. This is a "cross-functionality" and generates uniqueness.

6. RESULTS

6.1. Emission

In November 2008 the first cards were produced and on February of the following year 16 000 cards were delivered. Approximately two years after the beginning of the project, more than 23 000 cards were produced covering about 52% of the academic community.

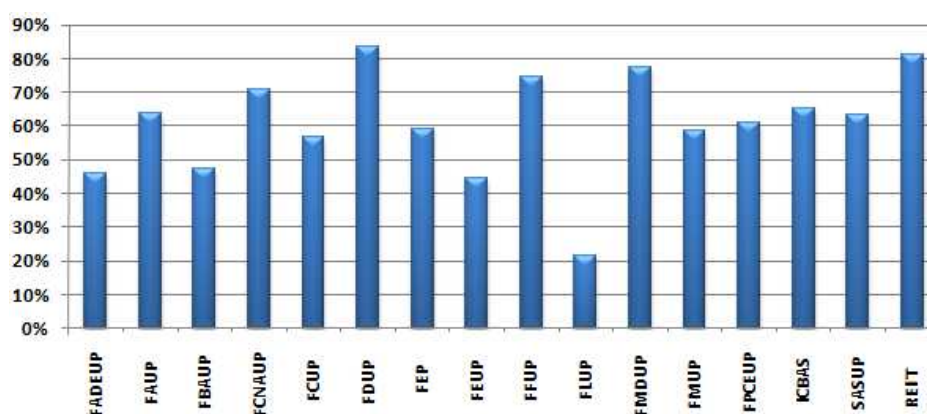Currently 31% of the organic units have values for adoption above 70% (see Figure 5).

Figure 5 – U.PORTO card: % Adoption

Considering the category of users, it can be seen on Figure 6 that at FMDUP, FBAUP and FDUP more than 90% of the respective staff adopted the card. In relation to students about 30% of the faculties have values above 70%.
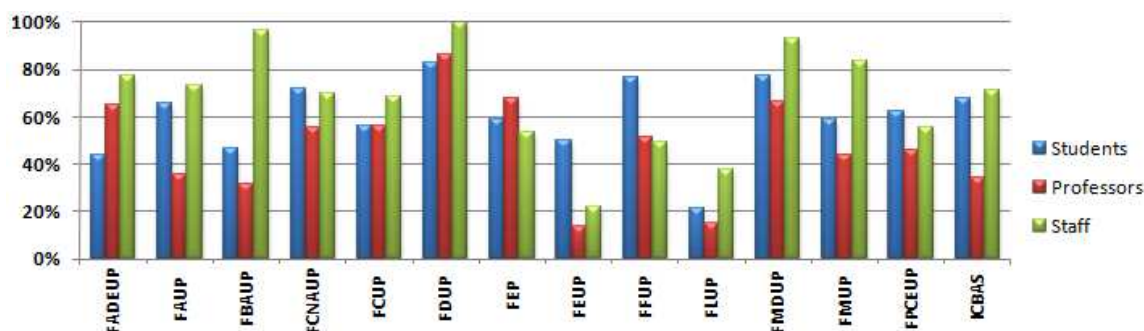
Figure 6 – U.PORTO card: % Adoption by type of user

Regarding the issuance process, some improvements are in progress. In fact, some delays were identified in the delivery of cards due to digital characters recognition faults implying inconsistencies with the University file. To overcome these difficulties SIBS is developing an online form to substitute the current paper form. Another important development relates to the disclose of MIFARE serial number for each card produced allowing improving the applications authentication and authorization process.

6.2. Functionalities

Nowadays the U.PORTO card is used at the University for user identification and for the utilization of several services, as described below.

Library loans

As most libraries have barcode readers, they were able to use the card since the beginning of the project, as the card includes a barcode with the identification number assigned to each U.PORTO member.

Attendance control

The U.PORTO card is used for registering staff's attendance by means of MIFARE technology in the Rectorate, FDUP and FBAUP. Implementation in FCUP, FLUP, FMDUP, FMUP and SASUP is starting.

Currently, the U. PORTO card is being produced with a random MIFARE serial number unknown to U.PORTO. Due to this fact a campaign to collect all the cards serial numbers was launched to associate them to the respective staff members.

An important economy of scale was achieved as several organic units are (or will be) sharing the same technical infrastructure in connection with SIGARRA for attendance control.

Printing and photocopying system

U.PORTO card's MIFARE technology is also being used for the printing and photocopying system, as it provides the mean through which a user may authenticate in the system. This functionality is currently implemented at the Rectorate, FMDUP, FADEUP, FDUP and ICBAS, being the installation process in progress in other faculties (FLUP, FEP, FAUP and FBAUP).

As mentioned previously, most faculties use equipment supplied by Xerox. The system consists of a server/client infrastructure based in Equitrac software to provide and manage the authentication process. The only prerequisite imposed by U.PORTO was the integration of the card's MIFARE technology in the authentication process, without interfering with the local previously installed system. For instance, specific card readers were designed for fitting in the equipment's security boxes, as shown below, see Figure 7.
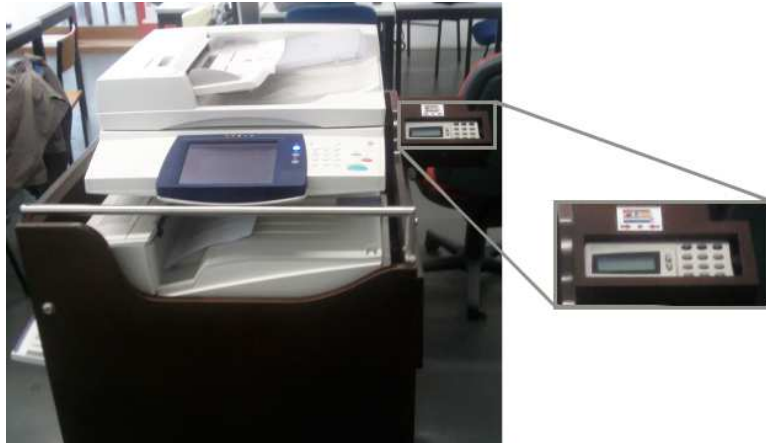
Figure 7 – Printing equipment at FDUP: security structure and reader adapter

Access control

Until now access control is used mainly for car parking and just a few faculties (FCUP, FMDUP and FEUP) have access control implemented for other spaces (e.g. labs) or buildings. Local systems are now being adapted to use U.PORTO card (MIFARE technology) both for car parking and for access control to student residences or other spaces.

Presently 48% of the features supported by the card are implemented and we expect to reach 71% at the end of this year. Additionally efforts are taking place for providing discounts in services like public transports or museums for U.PORTO card users.
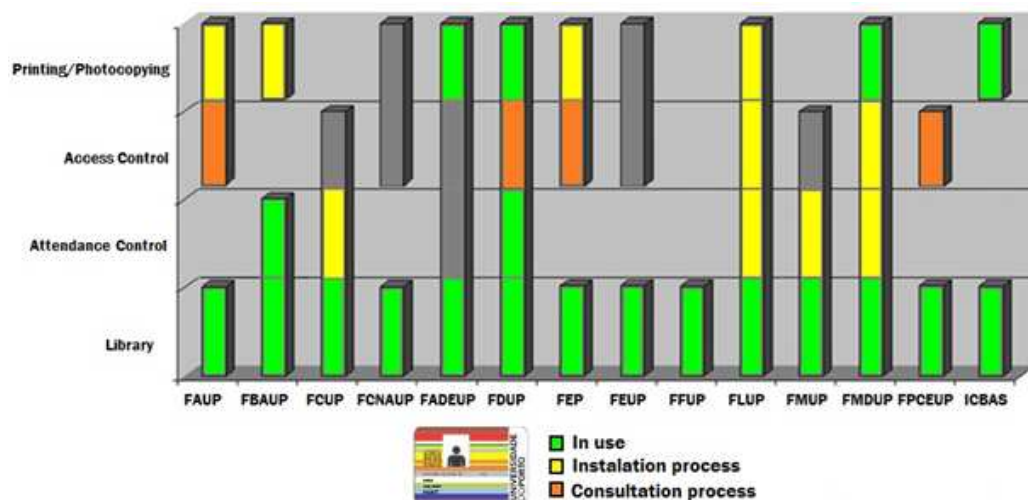

Figure 8 - Key features versus U.PORTO card: by faculty

Beyond typical applications, we are studying the implementation of new functionalities and services, the most important being:

**Digital signing and secure authentication**

In collaboration with the Computer Science Department of FCUP, we are testing the Classic Client solution provided by Gemalto. This application is a smart card-based crypto-library product that brings portability and the highest level of security to enterprise networks.

For these tests it was necessary to create a U. PORTO certification authority (CA), enabling to issue certificates for the card. To manage the Public Key Infrastructure (PKI) we selected an open source solution EJBCA to be integrated with the U.PORTO Lightweight Directory Access Protocol (LDAP), as required by the project.

The CA created enables the testing of the following functionalities in a closed user group (test team):

- Digital signing of documents and email, integrated with applications such as Microsoft Office, Adobe Reader, Mozilla Thunderbird, etc.;
- Encryption of emails and documents;
- Web authentication integrated with the most used browsers;
- Computer logon, integrated with Microsoft Active Directory (AD).
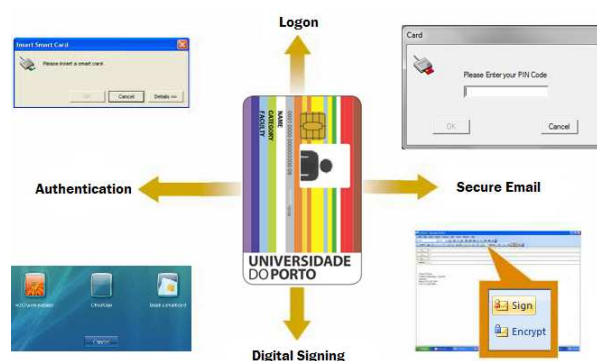
Figure 9 - Classic Client – Test done with U.PORTO card

It's also intended that the services offered to the U. PORTO card are extended to the national identification card (e-ID card) (Cartão do Cidadão Website, 2010). The national e-ID card provides also PKCS#11 cryptographic interface, however the fact that this card allows the qualified digital signature and timestamp provides our users with the possibility to issue a digital document with legal value.

The structure currently conceived to bear these features requires three different moments of interaction with the user (Figure 10).
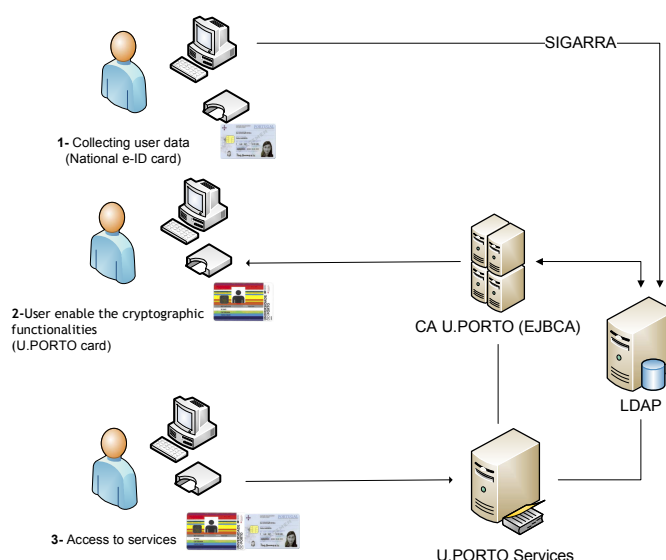
Figure 10 – Card cryptographic activation and use

Firstly it is necessary to assure the registration in SIGARRA when the user arrives at the U. PORTO. For this purpose we developed a Java applet that gathers the user information present in the national e-id card, including certificates (authentication and digital signature), and uploads it to SIGARRA. Secondly, after the user received the U. PORTO card, he ought to enable the card cryptographic functionalities and lastly, the user may access the services provided by U.PORTO using both cards.

Knowing that smart cards bring advantages to the users, in particular in online authentication with a high level of security (Burr, Dodson, & Polk, 2006), it is also our wish that the U.PORTO Authentication and Authorization Infrastructure - U.PORTOaai (U.PORTO - ICT Website, 2010) - supports the coexistence of the U.PORTO and the national e-ID card.

The U.PORTOaai is in production since March 2010, allowing federated authentication. The technical architecture is based on a *Where Are You From* service (WAYF), a central Identity Provider (IdP) connected with a central LDAP and a few Service Providers (SP) based on *Shibboleth* (SAML 2.0 standard), as shown in Figure 11.
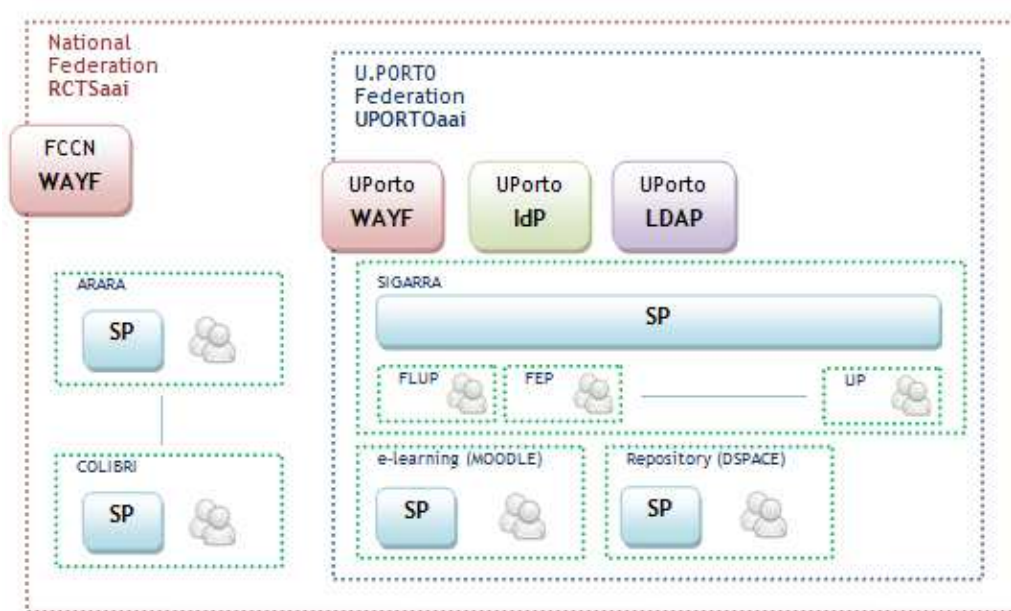

Figure 11 - Current U.PORTOaai infrastructure

The U.PORTOaai allows the user authentication in some services provided by U.PORTO and also in some services provided by the National Foundation for Scientific Computation (FCCN - Portuguese NREN).

7. FUTURE DEVELOPMENTS AND CONCLUSIONS

The U.PORTO intends to implement a payment system for students and staff to allow more efficient payment procedures and so decreasing cash circulation. The first organic unit where this system will be implemented is SASUP, as this unit is responsible for several bars and canteens in the campus. The solution is under study and should permit a future integration with other U.PORTO services, as shown in Figure 12. A bank account managed by the University will be provided where all values uploaded to the card are deposited, allowing central management and monitoring of all the financial movements.
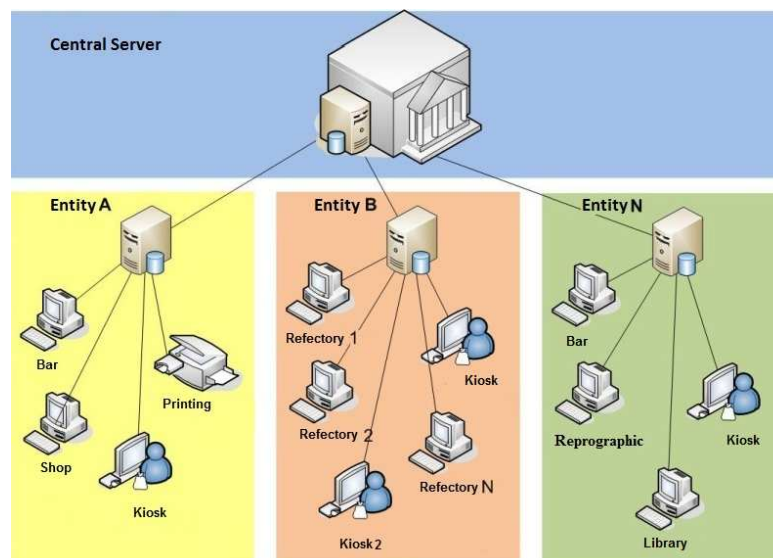
Figure 12 - Payment system solution under analysis

Another development being studied in partnership with Xerox is a distributed printing system that will enable students and staff to use printing and photocopying equipments all over the campus, although belonging to different faculties. The increase of internal student mobility justifies this capability.

The possibility of using the U. PORTO card in the city public transportation compliant system *Andante* (metro, bus and train) is also being evaluated.

Another vector of investigation is related with the increasing number of foreign students carrying out their studies at the University of Porto (almost 9% of all students) witch calls up the need of adoption of a standardized campus card system. We are therefore closely following the developments of the European Education Connectivity Solution Project (EECS Website, 2010), aiming at maintaining the compliance of the U.PORTO card with the directives that may result of this European project.

To conclude, and in spite of mentioned factors, such as the strong autonomy of the faculties, its geographical dispersion, the existence of previous solutions and in some cases the local production of faculties' own cards, added with some delays in the implementation of the new card functionalities, we may state that the U.PORTO card project is already a success.

Almost all management bodies of the different faculties and units of the University have expressed interest in adopting the U. PORTO card and teamed up actively in the implementation process. This reinforces the suitability of the U.PORTO's approach in proposing the adoption of a unique card to be used by all U.PORTO members.

Last but not least the project communication was also a key factor for the academic community adhesion to the University card. The U.PORTO Portal (based on SIGARRA) has a special section for the project where, beyond general information, people may find details about functionalities and the state of their implementation, technical details, FAQs (Frequently Asked Questions) and contacts for personalized support.

To evaluate user satisfaction and to identify and prioritize improvements in relation with the U.PORTO card facilities, periodic questionnaires will be issued by the University, the first of them later this year. Apart from this type of monitoring, one of our medium-term objectives is to conduct a study of economic impact to appraise direct economic benefits of the card utilization.

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