

## EUNIS Elite Award of Excellence 2012 Submission

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*Waterford Institute of Technology (WIT) established the Card Technology Research Centre (CTRC) in 2002. The goal was to create a centre of excellence in Ireland for card research, innovation, design and training. Its activities include card technology advancement, development of campus card solutions, and the promotion of standardised and interoperable card systems.*

*WIT was a founding member of the European Campus Card Association and the CTRC unit has been involved in numerous card projects throughout Europe and the USA. The CTRC was the lead developer of the European Education Connectivity Solution Project.*

## European Education Connectivity Solution

### 1. Project Summary

An increasing number of Higher Education Institutions across Europe are installing campus card systems, but these are often unable to communicate with each other due to a lack of standards and compatibility. This use of isolated, stand-alone, academic information systems is hindering the mobility of academics and students. The European Education Connectivity Solution (EECS) Project investigated a possible solution to this serious problem – the concept of interconnected and interoperable campus card management systems.

The CTRC at Waterford Institute of Technology was the lead developer for this project and supported by European Commission funding, the EECS Project was undertaken in the period June 2009 to May 2011 by a consortium of six organisations located in four EU countries. The projects results can be summarised as follows:

- It researched the current and potential European campus card market, the current state of the art, and likely future requirements
- It applied the research results to develop an innovative design for an integrated, standards based, EECS Campus Card prototype that could potentially serve the needs of European HE Institutions
- It developed a working EECS prototype for a secure and standardised campus card system
- The EECS prototype was then used to test the secure transfer and sharing of student records and other information between two European HE Institutions
- At all stages, the project sought to develop awareness of its new concept for campus card systems.

By the time of its completion, the EECS Project had successfully shown that academic mobility (an EU policy objective) can be facilitated by interoperable campus card systems, thus helping to overcome obstacles to the effective exercise of free movement of students and academics.

The architecture and technical design of the EECS prototype has no comparison, and represents a breakthrough in dealing with the problems of standards and interoperability that have up to now inhibited the development of the campus card market. The project attracted significant interest from suppliers and companies interested in the commercial exploitation of the foreground created.

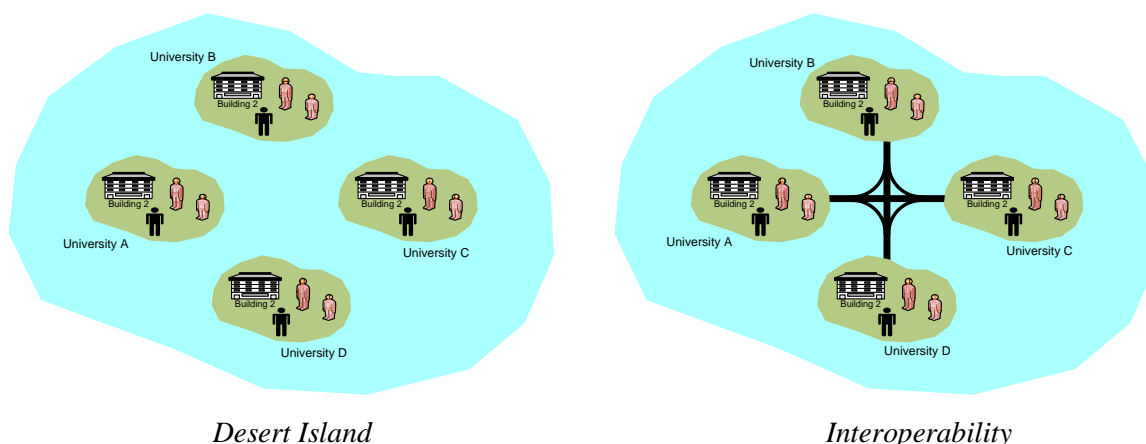
The CRTC is continuing to work with other organisations to further develop the results of the EECS Project, and the current goal is to have commercial products ready for implementation by 2014.

## 2. Background

It is an EU policy (the *Bologna Declaration* of June 1999) to create a European space for higher education in order to enhance the employability and mobility of citizens and to increase the international competitiveness of European higher education. The declaration calls for the elimination of the remaining obstacles to the free mobility of students (including trainees and graduates) and teachers (including researchers and higher education administrators). One such obstacle is caused by the operation by European Higher Education Institutions (HE Institutions) of many different campus card systems. The idea of a campus card system is that each teacher or student is issued with a single card or token which can then act as their secure key to access services and/or client applications - both on and off the campus.

Unfortunately, the campus card systems currently in use in the Europe Union (and indeed around the world) tend to be proprietary or highly customised. As a result, the campus card system in one HE Institution cannot interact with that in another due to a lack of common standards and technical interoperability<sup>1</sup>. This incompatibility prevents teachers and students from having quick access to basic academic information held in electronic form hence they move around the European HE Institution network, thus often requiring paper copies of documents to be carried and generally resulting in considerable management and administrative overheads - which is both inefficient and discourages mobility.

The current state for campus card systems can be described as a ‘desert island’ paradigm, with isolated, stand-alone, campus card systems that are unable to exchange data between HE Institutions in an efficient and timely manner; whilst the desired future state is interconnected campus card systems that enable the electronic sharing of student and teacher information in a secure and real-time manner. The present and desired future states are shown in the following diagram:



**Figure 2.a. Current and Future Campus Card Connectivity**

The obvious solution to the ‘desert island’ problem is to introduce interoperable campus smart card based systems at all HE Institutions in the EU. However, there are many challenges that have to be overcome before this can be achieved, including:

- The lack of a trans-national research infrastructure for campus card technologies
- A lack of common standards for campus card technologies, either in Europe or world-wide
- The absence of a standard minimum data set for campus card management systems
- No common standards for student/academic information exchange methods
- An inability to develop interoperable interfaces with the academic and non academic client applications now available because no common standard exists

<sup>1</sup> Interoperability of a campus card system can be defined as the ability of a card system to communicate and function with another campus card system or a range of campus card systems in one or a number of countries as required. Interoperability can be further defined as the ability of the card to be used in a range of applications in any number of campuses to authenticate the card user and provide access to a range of academic and non academic services.

- Language barriers
- The absence of an organised European academic data exchange network, linking campuses
- The high cost of developing a functionally capable campus card system.

However these challenges are not insurmountable. Many of the incompatibility and interoperability issues that campus card solutions in the HE sector are currently experiencing have already been resolved in other sectors, for example interoperable smart card technology is now widely used in areas such as commerce and banking, and for access control.

### 3. Project Environment

#### 3.1 Organisation

Because of the ambitious objectives and scale of the challenges faced, no single European higher education institution had the resources, skills and funding necessary to undertake the EECS Project, at least within a reasonable timescale.

In order to undertake the Project, it was necessary to assemble a European consortium comprising of three Small-to-Medium Sized Enterprises (SMEs) and three Research and Technology Development institutions (RTDs). The consortium consisted of the following members:

*SME Partners:* OneCard Solutions (Ireland); OPTeam (Poland); and Mecenat (Sweden)

*RTD Partners:* University of Zagreb (Croatia); Technical University of Łódź (Poland); and the Card Technology Research Centre at Waterford Institute of Technology (Ireland).

OneCard Solutions acted as the overall co-ordinating organisation, and provided project management services. A joint Executive Board had overall decision making authority and provided strategic direction.

#### 3.2 Funding

The total project cost was €1.5 million, to which the European Commission contributed €1 million under the FP7 Funding Scheme. The remaining cost was funded by the SMEs from their own resources.

#### 3.3 Approach

In order to achieve the desired goals, the consortium identified four key objectives for the EECS Project:

*Objective 1.* Research the current and potential European campus card market, current state of the art and future requirements.

*Objective 2.* Apply the research results to the design of a system architecture for an EECS Campus Card prototype.

*Objective 3.* Build and test a full working EECS prototype, including the key functions of card management, client application interface, data exchange and information transmission.

*Objective 4.* Develop a Marketing and Dissemination plan to inform potential customers of the new campus card system and to allow the project participants to exploit the project results by increasing product awareness.

These objectives were then used to inform the development of a detailed two-year long project plan, which included six work packages (each led by an SME) and sixteen defined deliverables.

## 4. Project Results

### 4.1 Achievements of Objectives

By its completion in May 2011, the EECS Project successfully completed all four objectives. This can be summarised as follows:

*Objective 1.* This involved research across 100 European HE Institutions in order to establish the current technological state-of-the-art, international standards, specialised HE needs and requirements, and legal and regulatory issues that could have a bearing on the project.

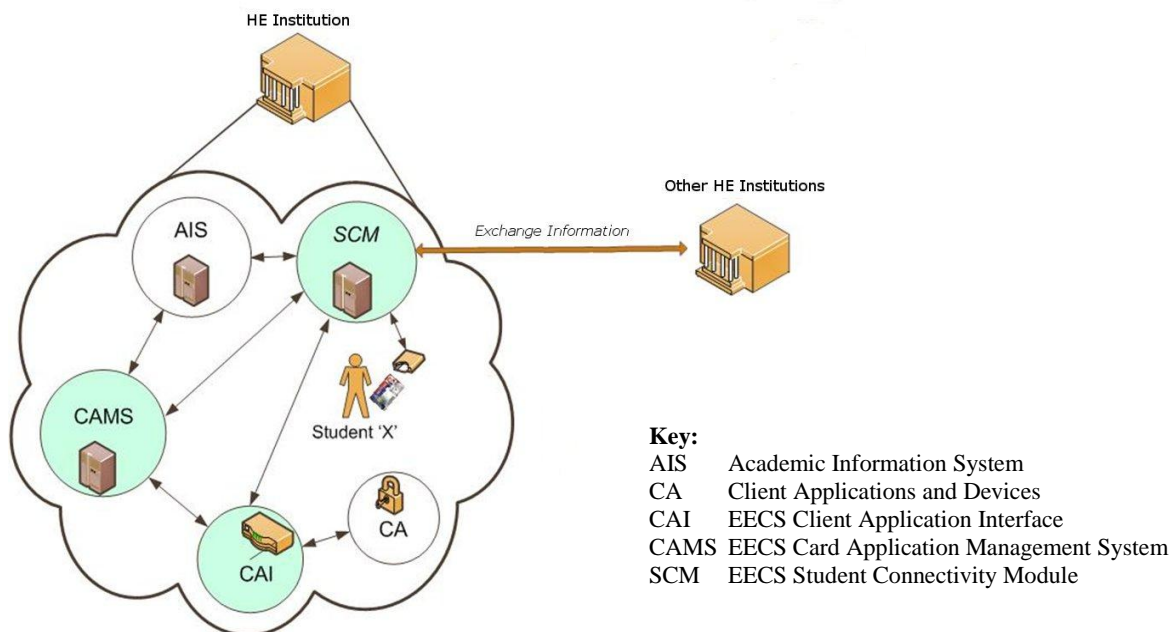
*Objective 2.* This resulted in the development of the requirements and specification for an EECS prototype with three core software modules. This was a key aspect of the project, and is therefore described further in section 4.2 below.

*Objective 3.* Once the three software modules had been developed, it was necessary conduct testing and validation checks in order to ensure that they could integrate successfully to form the completed EECS prototype, and meet the requirements. To complete the achievement of this objective, a real life student exchange then took place between two HE Institutions and the transfer of the required student information was authenticated by the use of the student's campus card. This is further described in section 4.3 below.

*Objective 4.* Significant dissemination activity took place throughout the project - in particular involving the European Campus Card Association (ECCA), the American National Association of Campus Card Users (NACCU) conference and at the European University Information System (EUNIS) conference. The project also had its own website ([www.eeccard.eu](http://www.eeccard.eu)). Although the EECS Project is now formally completed, dissemination and related activities will continue, for example in relation to publications and patents.

### 4.2 System Architecture

Objective 2 of the EECS Project was to design an EECS Campus Card prototype. Figure 4.2.a shows at a high level the components of the system architecture adopted for the EECS prototype:



**Figure 4.2.a EECS Campus Card Prototype Architecture**

The Card Application Management System (CAMS) at each HE Institution forms the core of the solution. It interfaces with an existing Academic Information System (AIS) and extracts all necessary information as required through an automatic updating routine. The Student Connectivity Module (SCM), through the

Client Application Interface (CAI) communicates with CAMS; the SCM also communicates with the AIS. All the Client Applications (CA) also communicate with the CAMS through the CAI. A smart card reader is connected to the SCM to provide a high level of security and authentication of all information.

The key characteristics of the adopted architecture include:

- Decentralized
- Flexible and modular
- Conformance to a set of recommended standards agreed with the ECCA in order to ensure interoperability and interconnectivity
- Use of a common identification card that acts as an “electronic key”
- Public Key Infrastructure used for university server’s mutual verification, with trusted X.509 certificates (e.g. issued by VeriSign, Thawte, etc.).
- Provides controlled access by academics and students to a range of campus services
- Enables the sharing of information and access to a student’s records held in secure databases
- Translates information stored on one campus card into a common format.

An additional important aspect is that there is no single server for student information processing; this avoids any potential conflict with the data protection policies that do not permit data storage and processing at other institution or on the territory of another country. Thus the cooperating university servers will communicate with each other on a peer-to-peer basis. This approach also reduces the costs of EECS deployment (no investments in common servers are required) and offers good scalability (demand for a common server computational efficiency would increase with the number of HE Institutions connected to it).

Once the architecture was designed, it was then necessary for the EECS Project to develop the three new core software modules that had been identified as being required. These are described further below.

#### **4.2.1 Card Application Management System**

The core of the EECS Prototype is the Card Applications Management System (CAMS). The CAMS processes information requests from a card user – in a full production system these requests would relate to the use of a wide range of facilities and services across the both the local HE campus, and potentially at external HE campus’.

The CAMS in fact consists of two main parts, the central database and the management software. The management software allows for Graphical User Interface (GUI)-based configuration of the main database, for example adding users, devices etc. The central database provides a backend that integrates and communicates directly with existing Academic Information Systems (AIS) and Card Production Systems in order to produce a campus identity card (or any alternative token).

The Card Production System links directly with the CAMS database in order to obtain all student information required for card/token production and personalisation, e.g. student name, photo. Once a token has been produced and personalised, a student can begin to use various applications managed by the CAI.

The CAMS and Client Application Interface are also designed to knit together to deliver a robust transactional micropayment system for vending, point of sale and other applications that require electronic payments either within or outside the campus environment. The system can provide quick and easy access to top-up and balances via mobile technologies and web based systems.

#### **4.2.2 Client Application Interface**

The Client Application Interface (CAI) is the middle-layer component of the EECS system; it provides a bridge between client applications and the central system and database - CAMS. These client applications

can then provide a wide variety of specific services: library eligibility, access control, vending, car parking, time & attendance, etc.

In order to support the greatest possible diverse variety of client applications, functionality and means of communication, the CAI is used to simplify and standardise the requirements for integrating with CAMS. The CAI module effectively acts as middleware, and provides an interface for client applications and devices to communicate securely with CAMS.

The CAI includes standard communication specifications for current and future applications, this helps to make interaction with CAMS efficient and future-proof. The main principle is that all communication is event-based and follows the exchange of standardised, application-independent request/reply messages. Data is exchanged using established industry standards, thus allowing many existing client applications to be easily integrated with the EECS solution. Communication between the CAI and CAMS database is performed via standard database procedures and functions which retrieve and return data as necessary.

#### **4.2.3 Student Connectivity Module**

The purpose of the Student Connectivity Module (SCM) is to support international student exchange. It is a web-based application that includes all the information processing, exchange and storage functions necessary to support student mobility by cooperating Institutions.

The SCM can retrieve information from an existing Academic Information System or other databases that contain data needed for student exchanges (defined in Erasmus and/or other mobility programme procedures). The SCM communicates with the CAMS by the use of the CAI, i.e. it is effectively regarded as another CA. Authentication and authorisation of users (staff or students) is performed by CAMS using an Authentication Token (AT) (e.g. smart card). SCM module receives data from the HE Institution database (not from the AT itself).

For the EECS Project, the SCM was based on the rules of the Erasmus programme framework. However the module can be easily modified to assist in student exchanges under other frameworks, e.g. between Institutions of a single country.

### **4.3 End User Trials**

#### **4.3.1 End User Trials**

As part of the test and validation process it was necessary to build an integrated test platform solution to conduct the various tests and trials in order to validate system interoperability and standards of the complete EECS prototype. Testing and validation of the EECS Prototype culminated with end user trials involving the exchange of students between Waterford Institute of Technology (WIT), Ireland and the Technical University of Lodz (TUL), Poland. The trials involved:

- Interoperability testing of the system between TUL and WIT
- Electronic transfer of student information between TUL and WIT
- Interoperability testing of Client Applications:
  - Academic applications e.g. library and time & attendance
  - Client applications e.g. vending, web/mobile phone value load and access control

The trials were a success and proved the interoperability and mobility potential of the new system.

## **5. Impacts and Benefits**

### **5.1 Innovation and Technology Integration**

The EECS Project leveraged and integrated many existing technologies (e.g. smart cards, contact and contactless interfaces, card readers, communication protocols, authentication mechanisms) – however the overall solution design concept has no comparison. For example the CAI and SCM are novel concepts, unique to the EECS Project, and represent a breakthrough in dealing with the problems of interoperability that have up to now inhibited the development of the campus card market.

The EECS Project adopted a novel approach to the problem of interoperability by focusing not on the individual applications but on the card management system and on the introduction of ‘standards’. Without standards, campus card systems cannot communicate because each system uses different and incompatible combinations of technologies, software packages and hardware sets.

A search of international patent databases has not revealed any published or granted patent applications that focus on development of standards for a campus card system. Nor can the partners find any evidence in the market or published literature that any other group is developing or offering for sale for such a system. From this we can conclude that the EECS concept for a standardised interoperable campus card system remains novel in the sense of new to the world and unanticipated in the sense of not being an obvious development and of providing an inventive step beyond the state of the art.

### **5.2. Benefits to Higher Education Institutions**

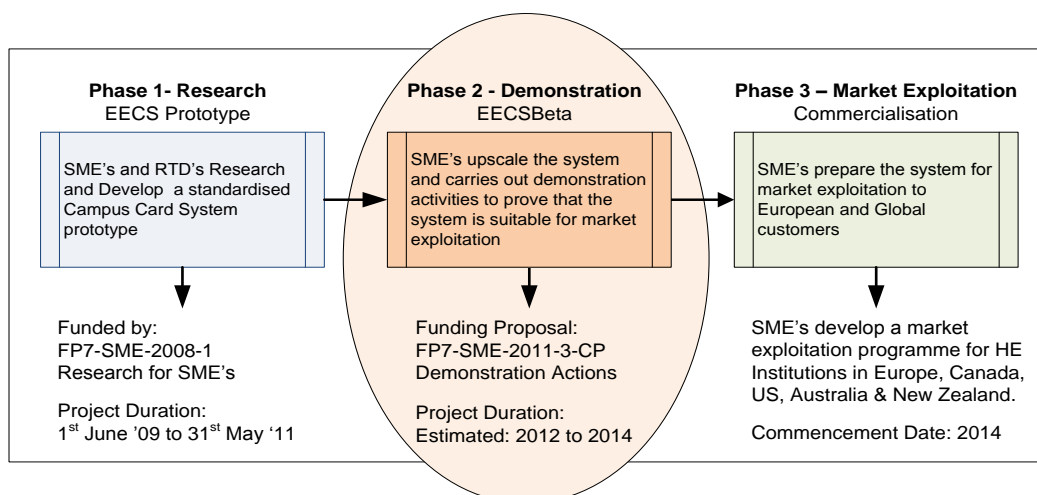
If, as expected, the EECS prototype is developed into a fully operational card system, there are many potential impacts and benefits for adopting HE Institutions. Examples include:

- Enhanced services (e.g. self service and cashless payment)
- Improved efficiency (e.g. reduced paperwork)
- Increased revenues (e.g. small charges for printing and copying)
- Reduced administration costs (e.g. automation of processes)
- Cost avoidance (e.g. lower overheads)
- Academic mobility.

## **6. Current Status and Planned Developments**

The EECS Project was completed in May 2011, with final reports being submitted to the European Commission in December 2011. The project attracted considerable interest; this was not confined only to HE institutions but extended to second level schools, hospitals and other operations that require secure access control, movement of data and connectivity with client applications. The project has also attracted interest and enquiries from suppliers around the world.

The completed EECS Project resulted in the basis for an integrated campus card solution, however the EECS prototype is not a complete solution and it will require further development and testing in a live environment before a mature product will exist that can be marketed to HE Institutions throughout Europe. The project partners are thus currently seeking additional EU funding for a Demonstration Phase (EECSBeta) that will bridge the gap between the research completed and the commercialisation of the product.



**Figure 6.a. Roadmap from Research to Exploitation**

In the meantime, the partners continue to develop and exploit the outputs of the EECS Project as rapidly as their internal resources and financing permits. This includes pilot demonstrations at two sites; the first is Waterford Institute of Technology (WIT) which went live in January 2012, whilst the second is the University of Rzeszow (UoR), which should go live in late 2012. OneCard Solutions are the lead partner in the installation and commissioning of the pilot demonstration at WIT whilst OPTeam is the lead at UoR.

The partners also propose to determine and publish a 'Standard for Interoperable Campus Card Systems' in conjunction with the European Campus Card Association (ECCA). This will allow suppliers and other organisations to develop applications and devices that conform to the standard, and are thus interoperable.

## 7. Applicability and Transferability

The EECS concept is applicable to all 4,000 Higher Education institutions (including Universities, Institutes of Technology, and Polytechnics) in the European Union. Relatively few of these currently have campus card systems, for example only 25% of Irish and 35% of Polish Institutions have such a system - compared to 75% in the USA – which may assist take up.

There is also a significant potential for also applying the outcomes of the EECS Project to a much wider range of markets. For example health care, international agencies and large corporations all have requirements which could be readily met by similar campus card solutions. The project results will also have significant potential for exploitation in relation to the development of the digital campus concept – including e-learning, smart classes, virtual teaching, digital library, cashless retail, on-line databases, paperless administration and collaboration.