EMREX in Poland supporting internal mobility

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1. ABSTRACT

EMREX [1, 3] is the ERASMUS+ Key Action 3 project (grant number 388499-EPP-1-2014-2-FI-EPPKA3-PI-POLICY) which aims at building a platform for an effective transfer of mobile students' achievements between partner institutions and thus promoting higher attainment level to student mobility in higher education. Five countries, Finland, Norway, Sweden, Denmark and Italy, agreed to add student mobility plug-ins (**SMP**) to local student information systems (**SIS**), set up national contact points (**NCP**) at country-level through which partner institutions may get access to data on student achievements, and run field trial. Poland is the evaluation body which is responsible in the project for the evaluation of the impact of the EMREX platform on the student mobility and the quality and scalability of the solution from the technical perspective.

To avoid legal issues of data privacy, the partners in the project decided that in EMREX data transfer will be initiated by data owners, i.e. mobile students. Student will log in to SIS of home institution, with help of SMP be directed to the NCP of the country of the host institution, be authorized by the SIS of the host institution, and trigger transfer of achievements.

The EMREX platform seems to solve a well recognized problem in a simple and elegant way. Development of the software components needed to join the network does not seem like a difficult task. The designed solution looks attractive from the perspective of the main stakeholders, mobile students and university administration.

Poland has a rich program of internal mobility, called **MOST** (Polish word for bridge), see [5]. In academic year 2015/2016, 534 students from 28 higher education institutions (**HEI**) spend semester or two in other Polish HEI. 15 of these institutions belong to **MUCI** consortium [6] and use the same SIS, called **University Study-Oriented System** (**USOS**, [7]). If the Polish partner integrates USOS with the EMREX platform mobile students from these institutions will be able to easily transfer their transcripts of records from USOS installation at host institution to USOS installation at home institution. The effect of scale will be immediate. If the system proves useful internally, going international will be an easy next step.

In the paper we describe EMREX solution for Poland internal mobility from the technical and organizational perspective.

2. INTRODUCTION

EMREX [1, 3] is the ERASMUS+ Key Action 3 project which aims at building a platform for more effective transfer of mobile students' achievements between partner institutions and thus promoting higher attainment level to student mobility in higher education and also encouraging more effective recognition of prior learning and avoiding overlapping studies. Five countries, Finland, Norway, Sweden, Denmark and Italy, agreed to develop student mobility plug-ins (SMP) to local student information systems (SIS), set up national contact points (NCP) at country-level through which partner institutions from other countries may get access to data on student achievements, and run field trial. Poland is the evaluation body which is responsible in the project for the evaluation of the impact of the EMREX platform on the student mobility and of the quality and scalability of the solution from the technical perspective.

To avoid legal issues of data privacy, the partners in the project decided that in EMREX data transfer will be initiated by data owners, i.e. mobile students. Student will log in to SIS of home institution using SMP, be directed to the NCP of the country of the host institution, be authorized by the SIS of the host institution, and trigger transfer of achievements.

The EMREX platform seems to solve a well recognized problem of timely delivery of student achievements in a simple and elegant way. Development of the software components needed to join the network does not seem to be a difficult task. NCP is (possibly) one per country, SMP is one per software developer of SIS, and there is also one central registry with binding information. The designed solution looks attractive from the perspective of main stakeholders, mobile students and university administration.

Poland has a rich program of internal mobility, called MOST (Polish word for bridge), see [5]. It is based on the rules similar to Socrates/Erasmus but is limited to students of Polish HEIs who want to spend one or two semesters at other Polish HEI. Program is coordinated by **UAC** (University Accreditation Commission) established in 1998 by the Conference of Rectors of Polish Universities. In academic year 2015/2016, 534 students from 28 HEIs spend semester or two in another Polish HEI.

There is a central admission system for MOST (called IRK-MOST) run by the University of Warsaw. The system also supports exchange of documents such as Learning Agreement and Transcript of Records; however the program coordinators and partner institutions have not yet decided to deploy that functionality.

USOS [7] is a student information system developed by the consortium MUCI [6] of 47 Polish HEIs. 15 of these institutions are involved in MOST. IRK-MOST, like USOS, was developed by MUCI, by the same development team which also takes part in the EMREX project. If the Polish partner integrates USOS with the EMREX platform mobile students from these institutions will be able to easily transfer their transcripts of records from USOS installation at host institution to USOS installation at home institution. The effect of scale will be immediate. If the system proves useful internally, going international will be an easy next step.

More challenging than software development are changes in institutional administrative procedures. Testing them internally can be a useful proof-of-concept.

Polish team decided to extend its role in the project and build EMREX components for Polish institutions using USOS. In this paper we present EMREX solution for Poland internal mobility from the technical and organizational perspective. Program MOST and its organization inside Poland is described in more detail in chapter 3. EMREX goals and the network architecture are explained in chapter 4. Chapter 5 contains description of EMREX for Polish HEIs from MUCI consortium and is the main chapter of this paper. Final thoughts are presented in chapter 6.

3. PROGRAM MOST

MOST (Polish word for bridge) is a mobility program for Polish students. It is based on the rules similar to Socrates/Erasmus+ but is limited to students of Polish HEIs who want to spend one or two semesters at other Polish HEI. Program is coordinated by UAC (University Accreditation Commission) established in 1998 by the Conference of Rectors of Polish Universities. The main goals of UAC's activity are:

- creation of an accreditation system of courses of studies at universities,
- creation and implementation of the standards of the education quality at universities,
- enhancement of the education quality,
- recognition of the HEIs ensuring high quality of the education,
- promotion of student mobility both in a national and international dimension.

Program MOST is carried since 1999. It involves 20 Polish public universities, members of UAC, and 8 associated HEIs. It covers over 400 fields of studies. Over 6000 students took part in the program since its start. Statistics for academic year 2015/2016 give some idea of the scope of the program:

- 2967 study offers,
- almost 1000 students registered in the admission system,

- 501 students qualified for studies at I and II level,
- 33 students qualified for doctoral studies.

Since May 2010 students register for MOST at one central admission system (IRK-MOST) available at http://most.uka.uw.edu.pl (see Figure 1), run by MUCI and located at the University of Warsaw. From the technical perspective the software has been based on the student admission system (IRK) developed by MUCI for Polish HEIs but was extended with additional functionalities [8]. IRK-MOST supports federated identity management, which means that students from HEIs which have central identity management system can log-in to IRK-MOST using their university credentials. Extra attributes may be sent from HEI's SIS during log-in, like student surname, name, citizen identity number, e-mail. Admissions are run twice a year. Students browse study offers from all participating institutions, select up to 3 study programs, make a priority list and wait for the final decision. Coordinator from UAC with the help of coordinators from partner institutions qualifies students for the mobility. Student's data can be transferred electronically from IRK-MOST straight to local USOS installation.

Figure 1 IRK-MOST — admission system for student mobility inside Poland

As is the case of Erasmus+ program, before the mobility students prepare Learning Agreements (LA) which have to be approved by coordinators from the home and host institution. After the mobility students obtain Transcripts of Records (TR) which have to be delivered to the student office at the home institution. IRK-MOST supports handling of these two documents. IRK-MOST may be integrated with HEI's course catalog (which is part of the ECTS guide), so when composing LA student can browse courses and transfer (upload) codes of those selected to LA. When LA is ready a special token may be sent to home and host coordinators giving access to LA in IRK-MOST. LA may be approved either straight in the system by the authorized person or the scanned version of the signed document can be uploaded into student's account and than its originality confirmed. After the mobility student may himself add grades to LA which is then converted into TR. Such TR has to get approval of the host coordinator. The signed and scanned document can also be uploaded to student's account. Whatever document is generated electronically from IRK-MOST it is signed with the application certificate. An electronic document contains PDF file to be read by human and XML equivalent which may be processed electronically by another application. Information about the current status of the document is attached (was it approved/confirmed by the authorized staff member of the involved HEI).

Handling of LAs and TRs is available in the system from its deployment in 2010. Various scenarios of information transfer between involved institutions are possible, more or less automatic. IRK-MOST can be regarded as one central point for exchange of documents on student mobility between participating HEIs. However this functionality is not used and documents are still exchanged mostly on paper.

What are the reasons? May be in 2010 university administration was not yet ready for such changes in the procedures? May be staff was not appropriately trained or convinced about benefits of the new way of document handling? Or may be administration prefers to stick to local SIS used daily, whereas IRK-MOST is more 'external', dedicated rather to MOST coordinators, not staff of student offices at faculties?

These or other reasons suggest that the simpler scenario, implemented in EMREX, where student himself is responsible for transfer of courses and grades from the host to the home SIS, might be a reasonable alternative. We decided to perform a proof-of-concept.

4. EMREX

Key components of the EMREX network are the following (see Figures 2 and 3):

1. EMREX-ELMO

   EMREX-ELMO is a standard for data exchange on the EMREX platform. It allows for description of home and host HEI, mobile student, courses, grades, credits, and other achievements. It is based on other European standards, like MLO-AD, EuroLMAI. All versions of the XML Schema are available on GitHub: https://github.com/emrex-eu/elmo-schemas/releases.

2. EMREG — EMREX Register

   This is the only central component of the EMREX network. For the lifetime of the project it is hosted in Norway and updated manually, but eventually may be hosted by some European organization (similarly to the EWP Registry, see [2]). There is only one service available — returning a list of all countries and their NCPs, for each NCP a list of all institutions it is responsible for and this NCP's public key. There is also a parameter saying whether a particular country has a separate NCP for each institution. In that case, after the country has been selected, the student is presented with a list of all NCPs registered for that country.

3. NCP — National Contact Point

   It is the entry point to the country's repository of achievement data. It must support secure log-in, result fetching and data transfer. Log-in service is either the federated identity management at the country-level or authorization at the HEI-level. The results can be fetched from a central repository or from a particular HEI. In the first case a student may in one step fetch results obtained in all institutions located in that country. NCP may give the student a possibility to select a subset of results to be transferred. It may also depend on the local solution whether failed courses are available for fetching. NCP generates the ELMO document in the XML format with attached PDF version optionally signed with the application certificate. XML is signed with the private key of the NCP.

4. SMP — Student Mobility Plug-in

   EMREX Client calls SMP each time it needs a list of institutions to choose from. The Client can cache the list for a certain period of time, as we don't expect the list to change too often. SMP may be implemented as a stand-alone web service.

5. EMREX Client

   EMREX Client can be built as a stand-alone application or as part of the existing SIS. It must implement secure log-in. It uses SMP to fetch the NCP list from EMREG, present the list to the student, forward the student to the selected NCP, and handle the response from the NCP. At that stage the Client should verify that the student logged into the local SIS is the same whose results are fetched from the NCP (by comparing some of the student data). The Client also sends to NCP a session ID and obtains it back in the response for the verification. It should display fetched results, give access to a signed PDF for download or printing. Eventually it should provide a way to store the results in the local SIS.

Security of the solution is obtained through login at the Client and NCP, HTTPS protocol used to transfer data over Internet, signing XML, validating a student at the Client.

Implementation is partly based on the existing infrastructure (student authorization, data repositories). Reusable parts of the implementation are open-sourced, available on GitHub (https://github.com/emrex-eu).
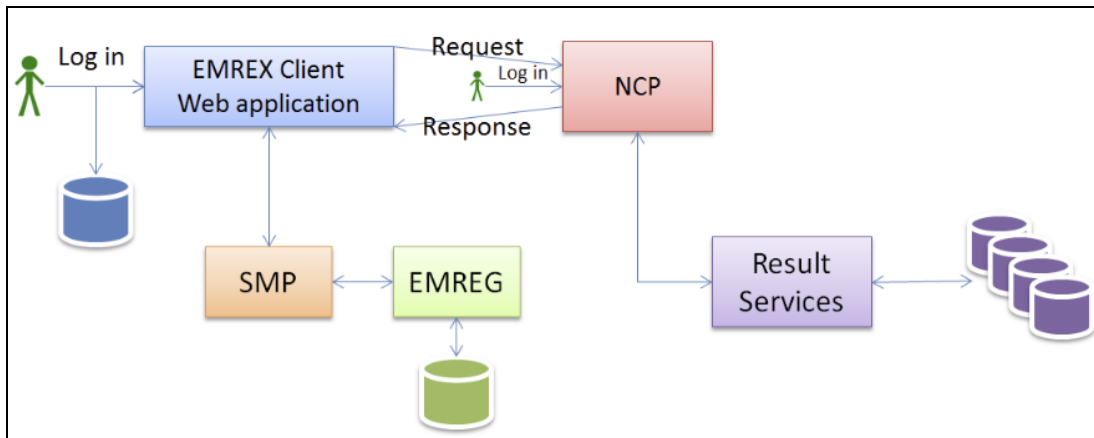
Figure 2 Main components of the EMREX network (from resources of the EMREX project)
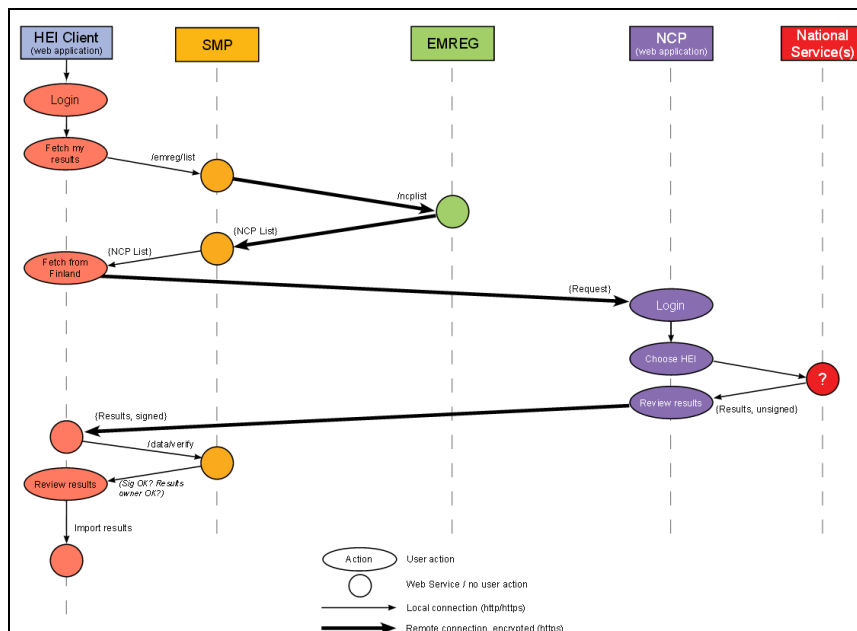

Figure 3 Scenario of data exchange via EMREX network (from resources of the EMREX project)

5. EMREX IN POLAND

In Poland, every HEI has a separate authentication system. There is also no central repository of student achievements. Having multiple NCPs, one for each HEI, seems to be the most appropriate option. This is yet to be decided how the list of NCPs will be updated in EMREG (PUSH or PULL).

5.1. Implementation of NCP

5.1.1. USOS API and USOSweb

Implementation of EMREX in Poland, developed by MUCI, is spread across two USOS subsystems:

- USOS API — a collection of web services, written primarily in Python, publicly documented in English, and designed for use by external consumers (see [4]),

- USOSweb — a web portal used by all students and staff members in their daily academic activities, written primarily in PHP (see [7]).

As stated before, every HEI in Poland which runs USOS has its own installation of both USOS API and USOSweb subsystems. For reference, you might take a look at the installation set up in the University of Warsaw:

- USOS API — https://usosapps.uw.edu.pl/developers/api,
- USOSweb — https://usosweb.uw.edu.pl.

5.1.2. Processing the NCP request

NCP endpoints are implemented in USOS API installations.

When an NCP request is received it is first validated. If it is correct, a unique identifier for this request is generated, and all the details of the request are stored in a database entity related to this identifier. These details may include request headers, IP addresses, etc. and are stored primarily for debugging purposes.

Once this is done, the user is redirected to the USOSweb subsystem.

5.1.3. User signs in and selects the courses

We have received the request, but we still don't know who the user is. Once the user accesses the NCP-related USOSweb web page, he is asked to sign in (see Figure 4).
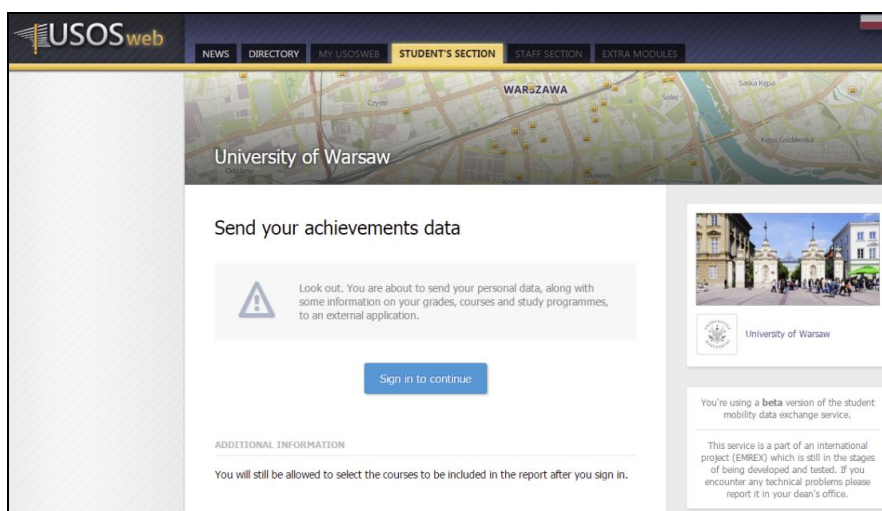
Figure 4 Logging to the NCP of the University of Warsaw

Once he does, the NCP request gets bound to this user (user ID is stored in the request entity). This relationship is permanent (if the user signs out and signs in as a different user, he won't be able to access this NCP request anymore).

Then the user is presented with the list of his courses and he is allowed to select any subset of them (see Figure 5).

Figure 5 Selecting results at the NCP of the University of Warsaw

5.1.4. The response is sent back to the Client

When the user clicks the **Send** button, the appropriate NCP response with the EMREX-ELMO document is constructed. Internally, parts of it are generated in the USOS API subsystem, but the end user will not see it, as all the communication is done in the background. Different subsystems need to be queried along the process, so this may take a couple of seconds (a user is presented with a standard "loading" icon during this time).

Immediately after the documents are ready, a POST request is being sent directly from the user's browser to the EMREX Client.

5.2. Implementation of the EMREX Client

At the time of writing, the implementation of the EMREX Client is under way (scheduled to be finished in May 2016).

As with the NCP server, the Client's implementation will be spread across two subsystems: USOS API and USOSweb.

A user initiates the EMREX exchange on a dedicated USOSweb page. USOSweb fetches the list of NCP servers via USOS API (USOS API is also responsible for caching EMREG responses). The NCP request is not sent directly from USOSweb, USOS API is used as a mediator. The student selects the NCP server on the USOSweb page, and then USOS API method is called with the server's URL. A unique ID is generated for this request (session Id) and a database entity is stored to track it. Then the user is redirected to the NCP URL with the return URL parameter referring back to a proper **receiver** USOS API **method**.

Once the student selects the courses and is redirected back to the receiver method, the underlying entity is updated and the received EMREX-ELMO document is stored and verified. The user is

redirected to the home USOSweb subsystem and presented with the results of the EMREX-ELMO processing. If the verification process goes well, and the local system is able to understand the data in the document, then it may additionally allow the student to select the courses which he would like to store locally (this being an extra option).

Suspicious import requests would need to be approved by an authorized staff member (the attached PDF document should be useful in this case).

5.3. Other issues

The solution will first be made available for testing on the USOS DEMO server. It is a test bed of USOS based applications, with anonymised data, fully functional, available for testers, training, and also for external companies which integrate their products with USOS.

A student who wants to transfer results from one HEI to another should log-in to both systems. Federated identity management for Polish HEIs would substantially help in solving the problem of student authorization. MUCI will recommend HEIs to join the federation. There is also a problem of the validity of a student account in home and host institutions after students leave the institution. It seems reasonable to keep these accounts active indefinitely, not only to assist students in accessing their data in the university repository but also to encourage them to maintain contact with their Alma Mater.

Electronic data exchange is a first step in the process of automatic recognition of student achievements, probably the easier one. Up to now it was the task of the local Erasmus coordinator to translate student achievements expressed in the context of regulations and culture of the host institution to that of the home institution. This translation also involves grade conversion. What was done by the human should be done automatically by the system. The system has to acquire the knowledge and experience of humans. This problem is yet to be recognized and worked out with the strong involvement of all interested stakeholders from European higher education institutions.

6. SUMMARY

Implementation of the EMREX Client and NCP for USOS will be made available for Polish HEIs from the MUCI consortium in June 2016 as part of the official distribution of USOS version 6.2. This means that the platform will become available to almost 50 HEIs in Poland after regular annual upgrade of the student information system, at no extra cost. Depending on the schedule participants of the program MOST will be able to get their results from host institutions starting from the summer semester 2015/2016.

Important aspect of the scenario supported by EMREX is that the initiative is on the side of the students and also the students are the potential benefactors. This may be the key to successful deployment.

As our experience shows, IT solutions should be tailored to needs/expectations/capabilities of the organization at its current stage of development. If the EMREX scenario proves useful it may open the door for more sophisticated scenarios, like the ones supported by the Erasmus Without Paper (EWP) Network. EWP project [2] aims to create a network supporting the electronic exchange of student data by interlinking the existing Erasmus student databases of HEIs. In EWP scenario data exchange will be under control of the administration, mostly staff of International Relations Offices. EMREX is the first step towards paperless world which is the goal of the EWP project.

7. ACKNOWLEDGEMENTS

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9. AUTHORS' BIOGRAPHIES

Janina Mincer-Daszkiewicz graduated in computer science in the University of Warsaw, Poland, and obtained a Ph.D. degree in math from the same university. She is an associate professor in Computer Science at the Faculty of Mathematics, Informatics and Mechanics at the University of Warsaw specializing in operating systems, distributed systems, performance evaluation and software engineering. Since 1999 she leads a project for the development of a student management information system USOS, which is used in 47 Polish Higher Education Institutions, gathered in the MUCI consortium. Janina takes active part in many nation-wide projects in Poland. She has been involved in Egracons, EMREX and Erasmus Without Paper European projects.

Wojciech Rygielski graduated in computer science in the University of Warsaw, Poland. He is a senior programmer working on USOS.

He is one of the main developers from Poland in EMREX and Erasmus Without Paper European projects. He designed and developed EMREX Client and NCP for USOS.