eSign ForStudy

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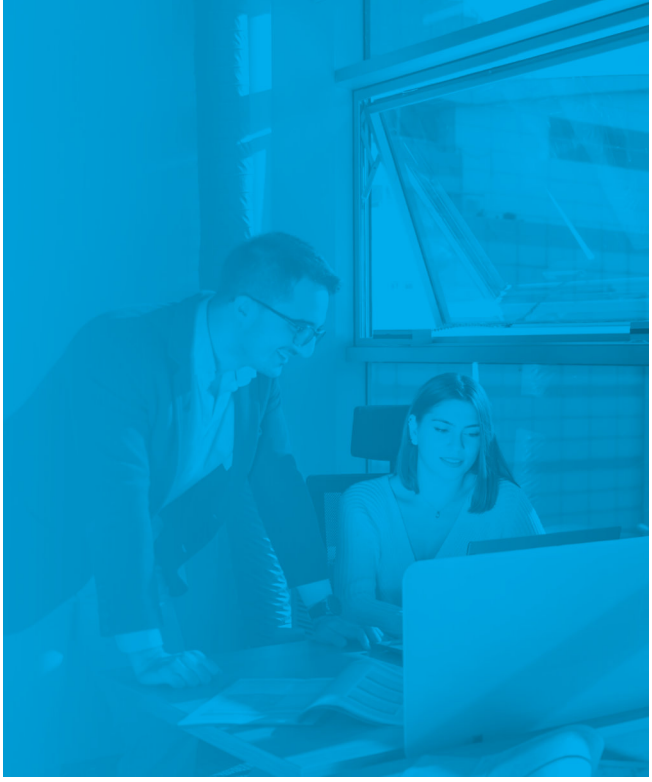
Signing made easy – hiding complexity of eSignature solutions in a black box



Introduction

For many years Higher Education Institutions (HEIs) have been actively incorporating digital solutions. The amount and diversity of documents produced in HEIs is substantial. Many of them need to be signed: both for internal use (e.g. student records supporting study processes) and for external use (e.g. documents on student achievements required for further studies or employment). Furthermore, some of these documents travel across borders due to the increasing internationalization of higher education in Europe and beyond.

In March 2019, DG EAC of the European Commission introduced the roadmap for the digitalization of the Erasmus+ Programme. This roadmap outlines specific dates for the introduction of the Erasmus Without Paper (**EWP**) standards [2].

EWP is a platform for the secure exchange of student records between HEIs [6], mostly focused on supporting student mobility processes [5]. Some of these student records need to be digitally signed and validated.

However, currently there are no easy-to-share, configurable (customizable to the scale of the institution), simple to install and use, low-cost solutions for storing digital certificates, signing documents and validating the signatures.

The **eSignForStud**y project [4], undertaken by partners from Poland, Ireland, and Czech Republic, addresses these needs and produces a solution that can be used both locally and cross borders.

About the Project

The objective of the eSignForStudy project was to design and develop a highly configurable eSignature solution to be used in the Polish higher education area, interoperable with **Erasmus Without Paper Network** for cross-border digital document validation. Polish HEIs range in size from 1,000 to almost 50,000 students and often share the same student management system. Therefore, they would benefit from easy-to-share, customizable, simple to install and use, low-cost solution for storing digital certificates, signing documents and validating their signatures. The **MUCI** consortium [8] includes over 80 HEIs, representing more than 50% of students from the public sector. They all use the same University Study-Oriented System (**USOS**) [10]. Therefore, developing digital solutions for USOS provides tremendous economies of scale.

University of Warsaw (UW), one of the members of MUCI, integrated eSignForStudy with USOS, for testing and validation. Czech Technical University (CTU) has developed its own student information system (KOS), with a built in International Mobility Module. EWP was used for the secure cross-border transfer of documents between KOS in CTU and USOS in UW. KOS has its own solution for signing documents and validating signatures. This gives the opportunity for cross-check and cross-validation of the two tools, the one from KOS, and the one built during the project, for the mutual benefit.

The solution is designed to resemble a black box with optional/interchangeable components and open interfaces to enable interoperability.

Benefits of Solution

- Provides an innovative solution for electronic signatures and electronic seals in compliance with eIDAS Regulation and standards.
- Supports the digitalizational process in European Higher Education Institutions.
- Removes the complexity and the diversity of solutions in the digital signing process. Easy to use for end-users (no requirement to use cards/readers and other technical devices).
- Supports the setup of complex eSignature workflows and addresses the need to have documents signed more quickly, timestamps for long term documents and logging of transactions for audit purposes.
- Enables cross-border exchange and validation of signed documents via the Erasmus Without Paper (EWP) Network.
- Increases interoperability and mutual recognition of electronic signatures across the EU.
- Well designed and easily configured for the signature services of the HEI that ensures convenience and efficiency e.g. supporting considerable signing of documents (e.g. thousands of student transcripts of records), using the institutional seal.
- Simple to manage, deploy and use in an environment where there is no highly qualified IT personnel.
- Low cost and ease of integration with existing student management systems, avoiding the requirement of additional hardware.

Project Technical Implementation & Infrastructure

The eSignForStudy project aim was to solve specific problems resulting from the general complexity and variety of eSignature solutions, which often become an obstacle hindering the implementation of these solutions, both in small institutions (due to the lack of technical support from local administrators) and in large institutions (due to the lack of solutions that scale well).

The solution addressing these needs should be seamlessly integrated within any ecosystem. It should resemble a **black box** with optional/interchangeable components and open interfaces to enable interoperability. End users (e.g. staff of student office or International Relation Office) send requests from the system supporting their business processes (like USOS with its various subsystems), transparently triggering digital signature procedures which, in turn, are forwarded to the black box using a unified interface.

The black box itself is integrated with other external systems needed to fully resolve the request such as, Qualified Certified Authority (**QCA**) or Trusted Timestamp Services (**TSS**).

All the underlying operational procedures and technical details linked to the developed solution, such as the types of managed certificates, media on which they are stored, security measures, software components used for validation etc. are hidden not only to the end user but also to system administrators, easing the deployment in the host institution infrastructure. To achieve this, the eSignForStudy solution is distributed in the form of preconfigured containers, while keeping customizability and scalability characteristics to fulfil with size and growing workload institution demands.

The general architecture of the final solution incorporated into the ecosystem of the University of Warsaw is depicted in Figure 1. Internally it supports the handling of certificates stored in local secure repositories – Hardware Security Module (**HSM**) or its software equivalent (**SSM**). If qualified signatures are needed and cannot be downloaded to the local infrastructure, they can be stored in a remote cloud managed by the Qualified Certified Authority (**QCA**) and handled from inside the institution's infrastructure by means of an API. The solution also enables the use of Trusted Timestamp Services (**TSS**) delivered by certified providers.

eSignForStudy eSignature Service is based on **DSS** open-source library [1] (by incorporating the library's code). It provides the means to create and validate electronic signatures and electronic seals compliant with eIDAS and related standards, to be used by Higher Education Institutions and private sector from member states of the European Union.

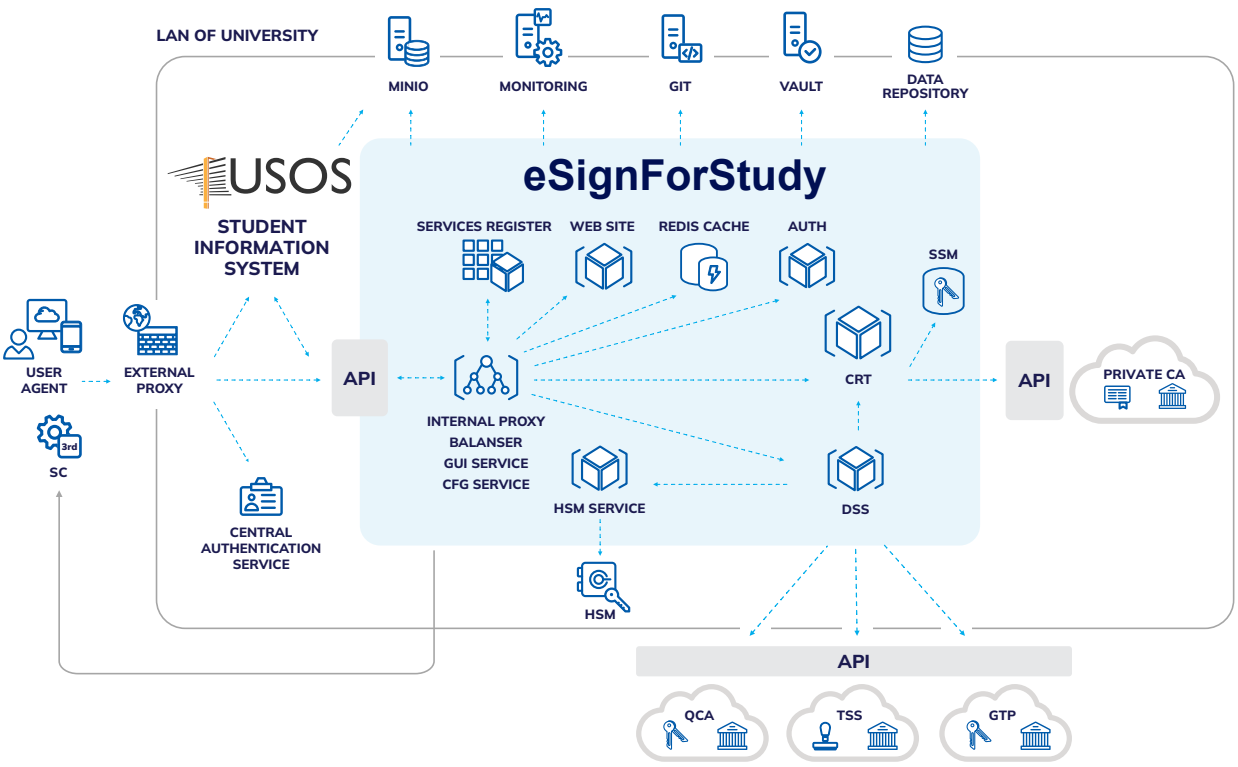


Figure 1: eSignForStudy – general overview of the internal structure

Signing Solution & Process

01 *USOS application selected for pilotage*

During the initial project stages as part of the business requirements analysis, processes and supporting systems belonging to the USOS family were identified, which involve digital signing. There are many, but after consultation with other HEIs using USOS, **USOSadm** was chosen for the pilot implementation. USOSadm is the application for the administration. It contains the module for handling Erasmus+ mobility. Transcripts of Records (ToRs) are generated for incoming students after they complete courses, and then delivered to the student home university. ToR is created in the ELMO format with embedded PDF, which should/could be signed. Bilateral Inter-institutional Agreements (IIAs), signed between partners in mobility, can also carry embedded PDF, digitally signed.

The analysis of the requirements revealed that the documents involved in the above mentioned processes, which will be stored in the institution's repositories for the longer time period, need to be signed with the qualified timestamp. Another important conclusion was that it makes sense to sign documents stored in the electronic repositories even if qualified signatures are not necessary – to preserve their authentication, integrity, non-repudiation and confidentiality. However, these issues have not been tackled within the project and therefore they are not described in this newsletter.

02 *Document storage*

The key features of the eSignForStudy are signing and securely storing signed documents. The analysis of the requirements shows that the number of files to manage depends on the process. In this sense, signing operations can be applied to individual files or in batch where thousands of files are sent for signature in one request (e.g. in the order of 5,000). This means that the solution should also incorporate a transfer of documents between the system sending requests and the signing system.

For many years large binary objects handled by USOS applications have been stored in a separate repository for such objects, known as **Blobbox** [9]. We anticipate that in the academic settings the demand for high-quality and efficient document storage will grow. Furthermore, we also have to take into consideration that some universities, especially the large ones, may prefer to outsource storing binary objects by delegating this functionality to existing cloud solutions, such as Microsoft Azure or Amazon.

For this reason, we decided to replace Blobbox with the alternative solution. Our choice is **MinIO** [7]. MinIO is an easy to install solution and offers what we consider an extremely important feature, S3 API support. This means that if USOS will use S3 API to access object storage, eventually every HEI would be able to use any storage solution implementing S3 API (which is a commonly supported standard). MinIO also solves the authorization issues, as it includes features that allow access rights to be transferred or delegated at single object level.

Therefore, we selected MinIO as the storage repository for integration of USOS with eSignForStudy. The process of replacing Blobbox with MinIO will be carried on gradually. Initially, MinIO will only be used to store documents exchanged between USOS applications and eSignForStudy. In a second phase USOS will be updated to use MinIO and all Blobbox records will be migrated to the new storage.

03 *Signing process in the integrated solution*

In this section we describe how USOSadm communicates with eSignForStudy. It is important to note that MinIO acts as the intermediary. There are two bucket folders accessible from both applications, one storing incoming documents from USOS directed to eSignForStudy (**in folder**) and the other for documents in the opposite direction (**out folder**). The process comprises of the following steps (Figure 2).

1. A user prepares documents for signing in USOSadm.

2. The application stores the documents to the **in bucket**'s **folder** in MinIO by calling the appropriate API. MinIO **in** and **out folders** are shared by USOSadm and eSignForStudy.

3. The application then sends a signing request to eSignForStudy. The request includes document identifiers in MinIO, and details of the operation, such as what type of signature is required, who signs it, whether a time stamp is needed, whether and where a visual form of the signature should be added to the document, etc. (see [3]).

4. The user is redirected to eSignForStudy which handles the whole signing process. This includes, in a loop, for each requested document:

   - retrieving the document from the in folder in MinIO,
   - signing the document,
   - storing the document in the out folder in MinIO.

5. Upon signing process finalization, the user is redirected back to USOSadm. The application collects the documents from the **out folder** in MinIO and stores them in their final location in the USOS database.

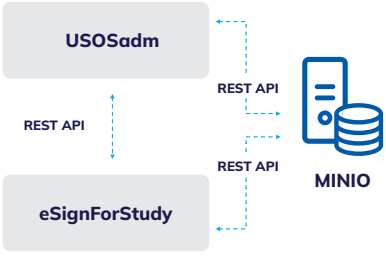


Figure 2: Communication between USOSadm and eSignForStudy using REST API and MinIO

The process of signing may end with error at any moment, which means that eSignForStudy has to properly report to USOSadm the status of each document. The end user may at any time open the browser and enter the page where the process started. USOSadm needs to be aware that the signing is in progress and does not allow the user to interfere with the process.

These issues are taken into account but error reporting needs to be further explored. Figure 3 demonstrates one of the USOSadm forms from the Mobility module. A user can select a set of Transcript of Records for signing, choose the signing mode and order the operation.

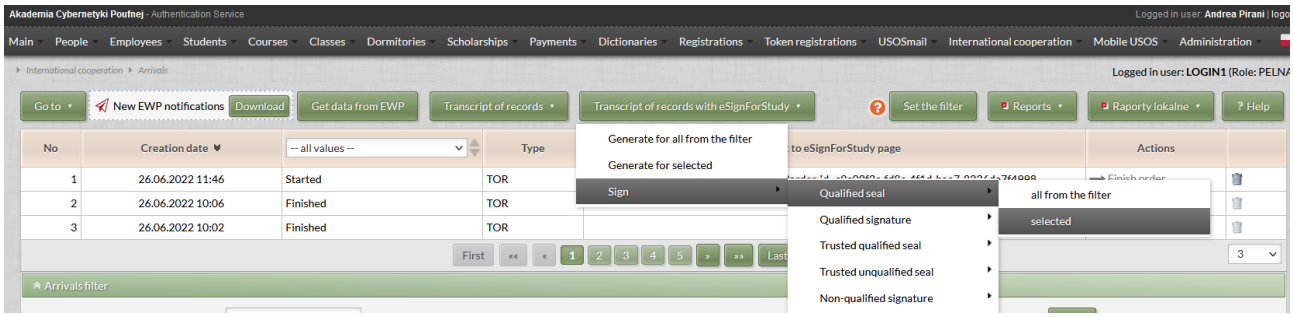


Figure 3: USOSadm – Arrivals form with a button for signing ToRs with eSignForStudy

Figure 4 demonstrates another form in which a user can see all documents of a particular person. The document shown has been signed with eSignForStudy what can be recognized by the logo in the right upper corner.

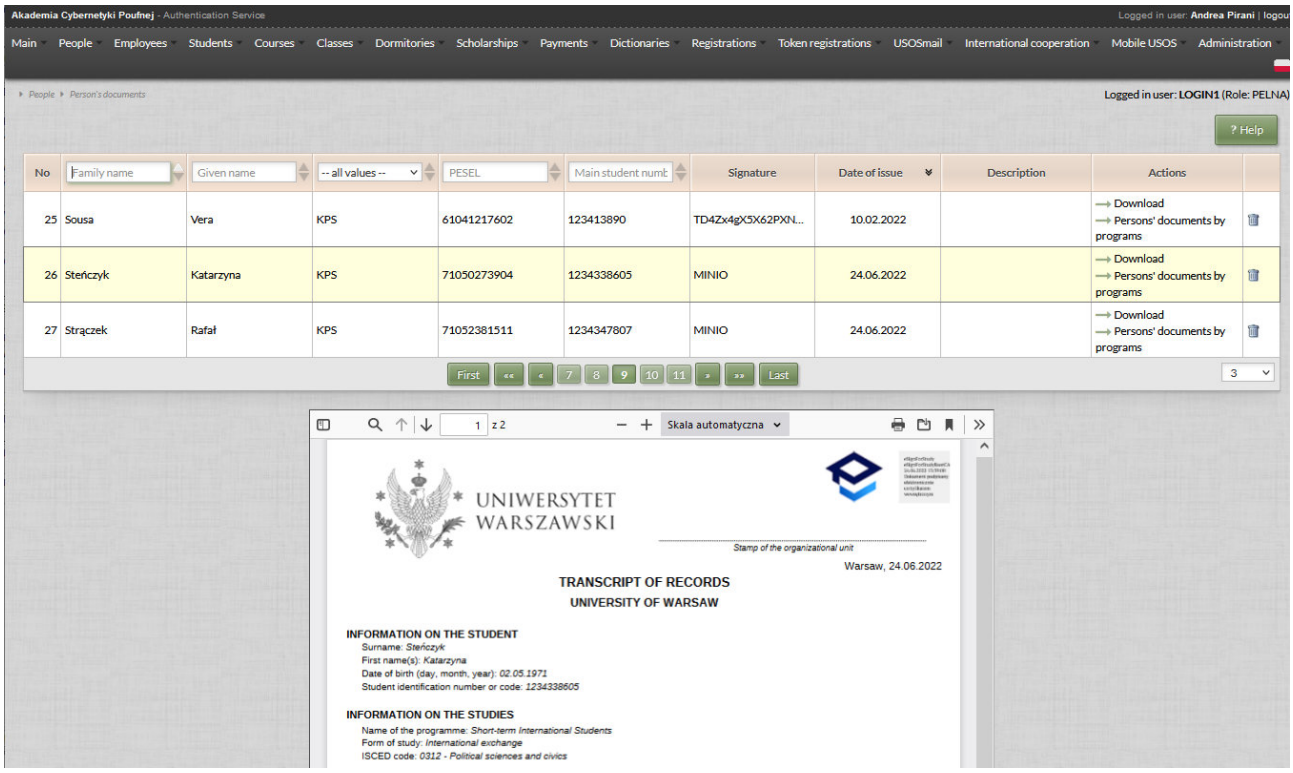


Figure 4: USOSadm – A document signed by eSignForStudy

Summary & Scope of eSignForStudy Solution

The eSignForStudy solution is aligned with the strategies and activities at Polish national level, by supporting digitalization of the Higher Education Area, and also on a European level, by supporting cross-border exchange and validation of signed documents, thus increasing inter-operability and mutual recognition of electronic signatures across the EU. When the solution is fully operational we will carry experiments to evaluate, from the user and institutional perspective, cost and effectiveness of various digital signing solutions, and prepare recommendations for HEIs – future users of the new system. Furthermore, although eSignForStudy is mainly focused to support educational requirements, it can also be configured and reused within any business sector, such as retail, finance, health care and beyond.

Thus, the solution's internal architecture should not be biased by educational frameworks, but it should allow for operation in a stand-alone mode or as a subsystem available through dedicated API. A modular approach, where each module exports its own interoperable interfaces and handles different exchange protocols, is foreseen. This way the final solution will favour different business models, expanding OPTeam exploitation plan.

In summary, the solution addresses the following requirements:

- Supporting legal cross-border recognition of eSignatures, obtained from Poland and abroad.
- Support for various types of eSignatures, either qualified, or issued by internal Certified Authorities.

Final conference

The final conference of the eSignForStudy project will take place on-line on **26 September 2022**. Join us **2:00-4:00 PM** to see live demo of the integrated solution. The ZOOM link to the conference:

https://us02web.zoom.us/j/82552366774

Agenda:

- Welcome, Introductions & High Level Overview (ECCA).
- Demo – Final Results (UW/OPTeam/CVUT).
- Q&A (UW/OPTeam/CVUT).

References

All links have been retrieved in September 2022.

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[2] Erasmus Without Paper project website (2022), http://www.erasmuswithoutpaper.eu.

[3] eSignForStudy API specification (2022), (use https://validator.swagger.io to explore) https://dev.opteam.pl/ui/public/esignforstudy/openapi.json.

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[5] Mincer-Daszkiewicz J. (2018). Mobility scenarios supported by the Erasmus Without Paper Network (full paper), EUNIS 2018, The 24th International Conference of European University Information Systems, 5-8 June 2018, Paris, France.

[6] Mincer-Daszkiewicz J. (2019). Erasmus Without Paper Network — from development to production (full paper in European Journal of Higher Education IT 2019-1, ISSN 2519-1764), EUNIS 2019, The 25th International Conference of European University Information Systems, 5-7 June 2019, Trondheim, Norway.

[7] MinIO website (2022), https://docs.min.io/docs.

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Project Partners

Disclaimer

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