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EU Cross-border and OOTS for HEI/Edu Workflows and Infrastructures with Interoperability, Standards, and Security

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Abstract

Looking at current efforts and strategies for implementing the Once-Only-Principle OOP/OOTS versus former Cross-Border CroB Principles in EU E-Government regulation/projects like SDG/TOOP/mGov4EU, we analyze these developments concerning the HEI/EDU integration, also looking at the different states and (central/de-central) structures in some EU Member States as well cross-border, where already digital services and standards are used, like EMREX/ELMO and EWP. Against this background, we make proposals for some improvements for interoperability for OOTS and CroB implementations for HEI/EDU with standards and security.

Key words: SDG, TOOP, eIDAS 2.0 / eID & TS, EMREX/ELMO, EWP

1 Introduction

Important strategic regulations and implementations for further digitization efforts in the EU internal market and public administrations are on the way – namely eIDAS 2.0 and SDG, which are going to influence through specifications and controls also the further developments at the area of HEI/EDU and student mobility, addressing also security and data protection. Underlying principles with some overlaps are here SSI (e.g. for eIDAS 2.0 wallets and applications, SSI) and OOP (e.g. for SDG portals), on the other hand some implementations for the area of HEI/EDU and student mobility are already in production at some EU member states since years with standards, like EMREX or EWP, other are going to be prepared for production like student energy cost (HIS, 2023) and National Educational Platform (NBP) (Hochschulforum Digitalisierung – Hochschulbildung im digitalen Zeitalter, 2022) in Germany. In this background, we examine important developments, structures and their overlaps, and make proposals for integration and interoperability based on standards. Important service areas in the context of the student-life-cycle to consider are: student applications, student certificates and diplomas, identification and authorisation (IAM) for secure system/service access.

The European Union has several common interests and operates as a single market. During the last decades, the need to further develop the Single Market and incorporate the aspects related to the digitalisation of the society. Consequently, the idea to transform the Single Market into a Digital Single Market (DSM) was outlined several years ago. The EU has started different initiatives to support this transformation process. One of them is the Horizon 2020 program to keep the process from a technical point of view. In parallel, initiatives were started to set up a sound legal framework for the DSM. The Single Digital Gateway Regulation (SDGR, EU SDG 20) is a crucial result of these initiatives. The core aspect of the SDGR is the underlying Once-Only Principle (OOP), outlining that businesses and citizens in contact with public administrations have to provide data only once. “The Once-Only Principle Project (TOOP)” was an EU-funded project initiated for research, testing, and implementation of the OOP in Europe. The mGov4EU project picked up the results with a focus on the transition of eGovernment into mGovernment.

Based on an analysis and presentation of the status quo between CROB and OOTS in section 2, we will present best practices from different EU member states in the context of the student life cycle in section 3. In section 4 we will go in detail on infrastructures, developments and interoperability. Our conclusion is found in section 5.

2 Analysis and Situation – CROB vs. OOTS

The once-only principle (OOP) is a concept in the broader context of e-Government that aims to ensure that businesses, citizens, and other organisations must provide specific information to administrations and governmental authorities only once. The OOP can be seen as one of the critical enablers for e-Government in Europe, as the Tallinn Declaration on e- Government emphasised it at the ministerial meeting during the Estonian Presidency of the Council of the EU on 6 October 2017, and as it was highlighted again by the Berlin Declaration on Digital Society and Value-Based Digital Government on 8 December 2020. The main objective of the Once-Only Principle Project (TOOP), launched in

2017, was to explore and demonstrate the OOP across borders, focusing on business data. The OOP is the core element of the Regulation (EU) 2018/1724 of the European Parliament and of the Council of 2 October 2018 establishing a single digital gateway to provide access to information, to procedures and to assistance and problem-solving services and amending Regulation (EU) No 1024/2012 (Single Digital Gateway Regulation / SDGR). In 2022 the EU launched Large Scale Pilots Projects for eIDAS 2.0 digital identity wallets, like "Potential[1]".

In 2022, an initiative was launched in Germany by the Federal Ministry of Education and Research (BMBF) to create a National Education Platform (NBP), starting with a research phase for building student/pupil services, teacher services and common infrastructures. The aim is to create a meta-platform that bundles access to the various education providers HEI/EDU by providing a single platform NBP as a hub center for distributed access to all de-centralized HEI/EDU provider systems.

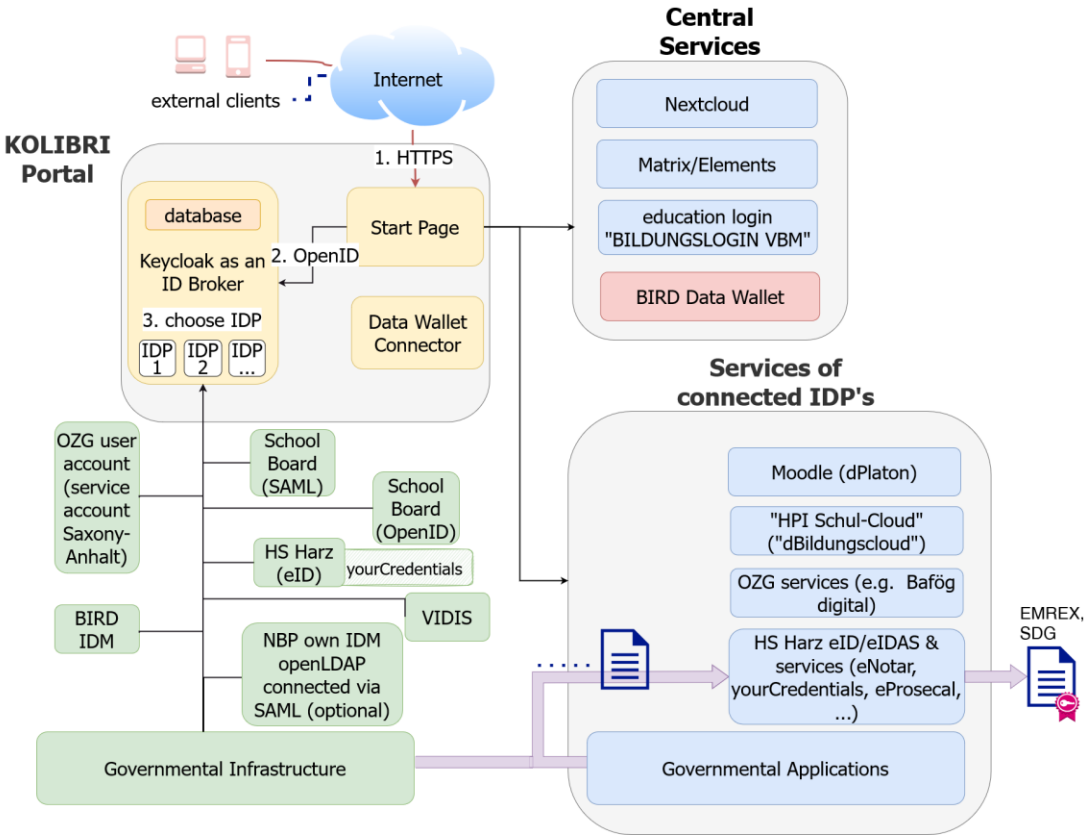

Figure 1: Architectural overview of the NBP infrastructure prototype KOLIBRI

Within the framework of the initiative, there were various pilot projects, including on infrastructure. The "NBP infrastructure project KOLIBRI" was one of these NBP infrastructure projects. The main idea of giving users a single point of access to different education providers was implemented in the "NBP Infrastructure Project KOLIBRI" through a central identity broker that enabled the connection of

[1] https://www.digital-identity-wallet.eu/

different identity providers (IDPs) as access points. These enabled users to use a Single Sign On (SSO) procedure to access the services of the various education providers. In addition, metadata about the services and providers as well as about the user logins were taken into account. This enabled the differentiation of the login according to EU EIDAS Level of Assurance (LoA, incl. LoA "high"), especially for logins via eIDAS/eID. Self-Sovereign Identities (SSI)/eIDAS 2.0 functions were implemented via the connection of user wallets. In addition, EU services such as EMREX/ELMO, Europass/EDCI/VC were connected. After the duration of the NBP infrastructure project KOLIBRI, some further additions were made by CyberSecurity-Group LSA, see Figure 1 and Chapter 5.

Another NBP project is the "Bildungsraum Digital" (BIRD) project. It was launched in spring 2021 and has a run time spanning the pre-pilot phase, pilot phase and development phase of NBP. The BIRD project is intended for research and development phase support across all production phases.

Right now, there are two systems in Europe for exchanging student data during stays abroad: Erasmus Without Paper (EWP) and EMREX.

EWP

EWP is based on an exchange of data between the offices of the participating institutions. The Erasmus Without Paper network (EWP) is used to share Inter-institutional Agreements for the Erasmus+ mobilities. It enables the efficient exchange of information on Erasmus students between higher education institutions. Many higher education institutions are working successfully with the EWP system, but some are also experiencing problems that lead to interoperability issues. Therefore, the European Commission's DG EAC and the EWP+ consortium led by the European University Foundation launched in 2022 an initiative to strengthen interoperability with the aim of achieving full interoperability for data exchange in the EWP network. (Janina Mincer-Daszkiewicz, 2023) Both protocols EWP and EMREX are using ELMO as document format.

For the questions of protocol security and authentication, EWP initially assumed a prescribed TLS solution for all security questions (server authentication, client authentication, encryption). This turned out not to be feasible, which is why the "EWP Authentication and Security" is now divided into different independent parts, from which server and client side can select the respective supported and suitable solution.[2] The authentication parts described so far include the TLS solution, HTTP signatures and, on the client side, an anonymous login. For (transport) encryption, in addition to TLS and response confidentiality, a solution called EWP-RSA-AES128GCM Response Encryption is in draft form.

Concerning document security, the data format for the Transcript of Records in the EWP is analogous to the corresponding data format in EMREX/ELMO. This offers the possibility of document signing. A corresponding signature is not mandatory from a technical point of view, but is regulated at organizational level by higher education institutions.

[2] https://github.com/erasmus-without-paper/ewp-specs-sec-intro/tree/v2.0.2

In contrast to EWP, the EMREX network is owner-controlled. This means that the data to be exchanged is transmitted by the institution to the student through active actions on the part of the student and can then be passed on by the student to another institution.

EMREX/ELMO

The EMREX Community[3] has been working since mid-2022 with directorates of the European Commission on an interoperable ecosystem for the digital transport of educational data(Gottlieb & Bacharach, 2023). In the meantime, a mapping table of data fields of the current ELMO standard version 1.7[4] with data fields of the future European Learning Model version 3 (ELM)[5] has been created in cooperation with DG EMPL. It is now clear that ELM V3 and ELM Version 1.7 are 100% semantically equivalent. With the EU project DC4EU[6] a converter is to be developed in the next two years on this basis, which is to convert data in the ELMO standard into the ELM standard and vice verse.This will be the base for the EMREX gateway, that should provide a converter that shall allow educational institutions, together with ELMO to ELM converter, to make a bridge between federated/centralized solutions and VCs SSI paradigm

Since ELMO version 1.7 is used as the standard for the data transport systems EMREX and Erasmus-Without-Paper (EWP)[7] and ELM version 3 shall be the standard for the systems Europass and EBSI in the future, it will be possible to use an interoperable ecosystem between these two systems via convertible data standards. This interoperable ecosystem would be supported and extended if ELMO or ELM also became the structured standard for education data of the Single Digital Gateway (SDG) or national standards. In the area of educational data, SDG still has the need to fully collect data necessary for educational processes. However, this is planned in the form of workshops. The German data standard for education data XSchule and XHEIE, respectively, have already announced such compatibility with ELM.

A further step towards comprehensive European interoperability has been developed by working groups of the EMREX Executive Committee and SDG/OOTS since winter 2023. EMREX, which is mentioned in the Commission Implementing Regulation (EU) 2022/1463 as a sectoral solution for education data, will be connected to the OOTS via a bridge system in the near future.

The general approach of OOP means using base registries as information sources that always keep the latest version and that can provide information on request or subscription. To explore and demonstrate the functionality of OOP within the project, it was agreed to select multiple pilots and develop a set of guiding concepts and appropriate methodologies. The TOOP project ran pilots in three different domains, General Business Mobility (GBM), Maritime, and eProcurement, in fifteen Member States:
In the GBM pilot, it is considered that a Legal or Natural Person requires data about their company to use in a service, e.g., to issue a certificate for their company. In the Maritime pilot, it is considered that a Legal or Natural Person requires a certificate for their or their company's ship and crew. In the

[3] https://emrex.eu
[4] https://github.com/emrex-eu/elmo-schemas
[5] https://europa.eu/europass/en/european-learning-model
[6] https://www.dc4eu.eu/
[7] https://erasmus-plus.ec.europa.eu/european-student-card-initiative/ewp

eProcurement pilot, the objective is to get qualification evidence from a data provider for economic operators that are submitting a tender. The GBM pilot can claim that its results got directly adopted by the official target constituency since they were taken as the basis for the SDG Once-Only Technical System (OOTS). One of the project's main goals was to develop extensible technical components that could be reused in other domains, e.g. education.
Trust and information security are two cross-cutting concerns of paramount importance. The architecture of TOOP relies on the concept of trusted sources of information and the existence of a secure exchange channel between the Data Providers and the Data Consumers in this interaction framework (Boldrin et al., 2021), see Figure 2. The implementation of trust relies on the eIDAS Regulation.

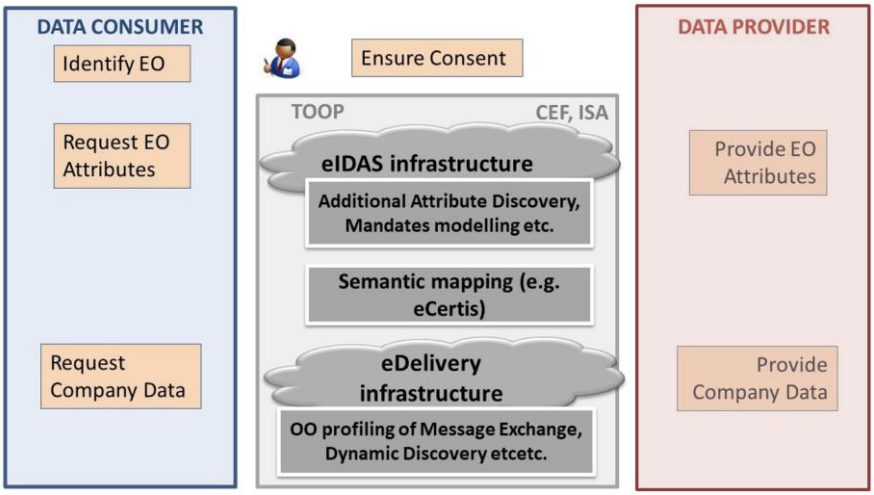

Figure 2: Infrastructure view of the TOOP flows

3 Status and Best Practices EU MS

3.1 HEI/EDU register and services in Croatia

In Croatia the transcripts of records are signed with the qualified electronic signature under the eIDAS scheme. However, due to an additional requirement imposed on all public services, the PDFs must also contain a unique serial number. This number enables a verifier to make sure that the document is genuine and unaltered even if the user prints a physical copy of the transcript of records. The check is performed by inputting the serial number on a public web page of the issuing authority upon which the data is displayed in HTML form and unsigned. The serial number ceases to be valid after 6 months but during that time the data of the student is easily accessible by anyone who has the serial number of the transcript of records. This represents a major design flaw which has been implemented to facilitate easier use of “digital” documents among a population with very low understand of how digital signatures function. The trade of in ease of use has resulted in a significant decrease in security and privacy of user data. This results in the digital system becoming less secure than traditional paper

systems only for the purposes of increased market penetration, something that can be seen even today on a larger EU level with the upcoming European Digital Identity initiative as part of eIDAS 2.0.

3.2 HEI/EDU register and services in The Netherlands

DUO (Executive Agency of Education), on behalf of the Ministry of Education, Culture and Science, is responsible for collecting, managing and providing access to of all education recognized by the Ministry. This ranges from citizen's exams to diplomas in higher education.

The data is made available to potential users via the "My diplomas" service in three ways, namely via a down-loadable PDF, direct M2M connection and EMREX. See schematic representation in Figure 3.

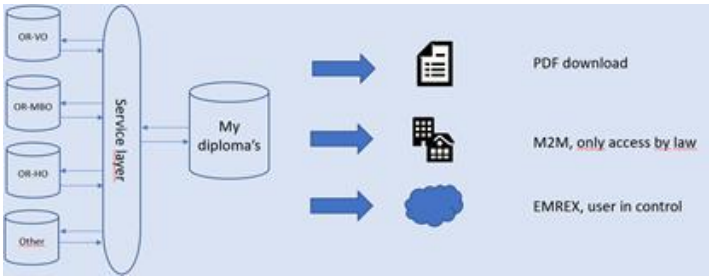

Figure 3: My diplomas service flow

The structured data is stored and managed in a database per sector. The PDF, a digital representation of the result achieved, is provided with a qualified electronic signature, just like in Croatia. The certificate is included in Adobe's AATL and must be equivalent to a "PKIoverheid" certificate. The PDF is only valid as a digital document and loses its value when printed. This is also the bottleneck, because despite a short explanation at the bottom of the document, the recipient (often employer) of the document does not know that the document is only valid in digital form.

DUO tries to pay attention to this nationally through communications. In addition, the plan is to take technical measures this year to improve the checking of the authenticity of the document.

Another challenge that is often discussed is keeping digital diplomas available for the future. How do you ensure that digital data can still be used in 60 years? At DUO, digital results and registrations are stored per sector. Each sector has its own results and enrolment register. These registers can best be described as operational registers, which means that they are always migrated to the latest situation. It is therefore not a frozen register or an archive. By applying Life Cycle Management in an Agile way of working, older data is always taken into account with changes or new policy. In this way, DUO meets a future need for usable digital diplomas.

3.3 HEI/EDU register and services in Norway

SIKT (Norwegian Agency for Shared Services in Education and Research) is a public administrative body under the Ministry of Education and Research. Through cooperation with users and customers,

Sikt provides a shared infrastructure for Education and Research that ensures user experiences in compliance with the general goals for digitization, data sharing and open research. This ranges from citizen's exams to diplomas in higher education. For results, this includes services like Student information system, Exam systems, long term storage for results and public portal (Vitnemålsportalen) for accessing and sharing results from education.

For higher education the Diplomas, Diploma Supplements and Transcript of Records are fully digitized for higher education. The same is about to happen for results from upper secondary school. Results from education can be accessed by all citizens using Vitnemålsportalen and can be shared with third parties either via link[8] or via the EMREX protocol, see Figure 4.

In addition to sharing structured data, Diplomas, Diploma Supplements and Transcript of Records are also available as qualified signed PDFs.

Further development of the portal is to include all levels of education and open the data for more processes. The portal will provide gateway to wallets, become the access point for education data for SDG, and provide data for organizations having the legal right to assess this information.

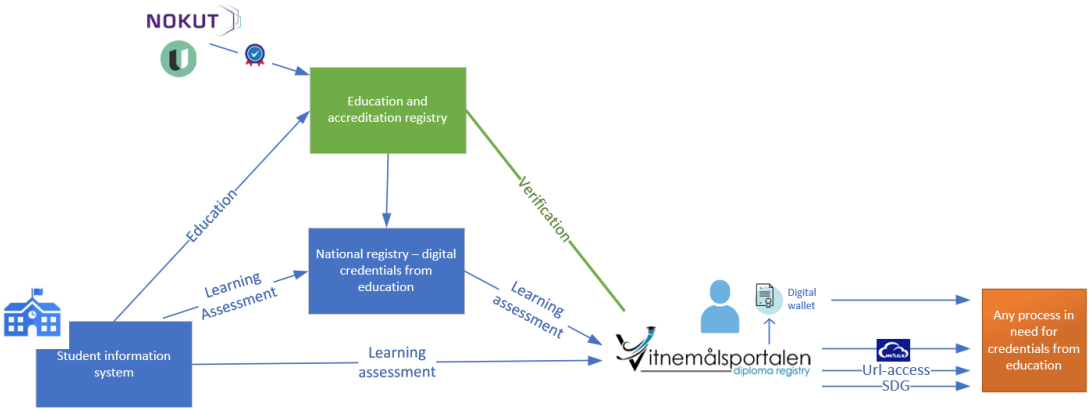

Figure 4: Vitnemålsportalen eco system

A national accreditation registry is being developed and will include a verification service to verify the issuer of the results.

3.4 HEI/EDU register and services in Sweden

In Sweden there is a central Student Information System Ladok led by the universities themselves. It is developed and operated in common as one single installation but according to Swedish law a HEI can only access its own student data so each HEI sees only their own students. Still this central installation means that if each HEI grants access, central parts and processes can be kept, for instance a common

[8] https://www.vitnemalsportalen.no

student register and EMREX that fetches info from all HEIs. Ladok is not commissioned by the state or law, it is just a fruitful cooperation.[9] Apart from that the admission in Sweden is central, by law and done by one authority, UHR. The results of the admission are sent electronically to each HEI. UHR also maintains a database of grades from Upper secondary school. Both that info and results from HEIs are collected automatically in each admission round.[10]

There is some admission at each HEI, mainly exchange students with the reason that they are handled in separate systems.

Work is ongoing with integration with electronic IDs and signatures. So far it is possible in Ladok to issue digital diplomas and sign them[11]. It is also possible to use national eID such as "BankID"[12] or "eduID"[13] to create a local account in Ladok or the admission system

3.5 HEI/EDU register and services in Estland

The higher education system in Estonia follows the Bachelor-Master-PhD model of the European Higher Education Area and comprises three cycles. Higher education in Estonia is regulated by law and based and the following legislation: the Republic of Estonia Education Act, the Higher Education Act, and the Standard of Higher Education.

To unite all relevant data, the Estonian Education Information System (EHIS) was established in 2005. EHIS is a state register which connects the databases of the Estonian education system. It is a public register that allows everyone to inspect the performance indicators of preschool childcare institutions, primary schools, upper secondary schools, and vocational educational institutions. EHIS is a personal-identity-based database, which means that each person is registered with an individual identification number. EHIS is intended for persons acquiring general, vocational, higher or hobby education and teachers and academic staff working at the same level. Aside from the state-owned register, the data is also available via the Estonian Qualifications Authority (Kutsekoda). It is a private legal entity, co-financed by the European Social Fund, developing a support structure for the occupational qualifications system to increase the competitiveness of Estonian employees and promote the development, assessment, recognition and comparison of their occupational competence. The data for both systems is collected by using the national backbone infrastructure called "X-Road". Entry and access to the data that is not publicly available ensured by the usage of e.g. the national eID. X-Road is an open-source software and ecosystem solution that provides unified and secure data exchange between private and public sector organizations. The identity of each organization and technical entry point is verified using certificates that are issued by a trusted Certification Authority (CA) when an organization joins an X-Road ecosystem. It also supports encryption and the implementation of the OOP and OOTS.

[9] Best description is here (in Swedish, to translate): https://ladok.se/ladok/detta-ar-ladok
[10] see https://www.uhr.se/en/start/system-support-services/system-support-services-for-higher-education-institutions/
[11] signing is available by https://edusign.sunet.se
[12] https://www.bankid.com
[13] https://eduid.se

3.6 HEI/EDU register and services in Germany

In Germany, there is currently only a central admissions office (Stiftung für Hochschulzulassung - SfH) for access to admission-restricted degree programmes; all other admissions are decentralised via the respective HEI.[14] No increased security is used, only a username/password is used.

Various regulations, laws and programmes are currently in the specification, development and implementation phase. This concerns the implementation of the Online Access Act (OZG) for the HEI/EDU area incl. eIDAS eID/TS, the Act on the Payment of a One-off Energy Price Flat Rate for Students (EPPSG) with eID, the development of a National Education Platform (NBP) with OZG integration and the register modernisation.

To cushion the impact of the sharp rise in energy costs in Germany, a one-time payment of €200 was agreed in December 2022 to all students and student specialists in Germany enrolled as of Dec. 1, 2022. A total of approximately 3.5 million people, including 2.95 million students and approximately 450,000 technical pupils, are eligible. The Studierenden-Energiepreispauschalengesetz (EPPSG)[15] sets out the legal basis.

Due to the federalism in Germany with 16 federal states and freedom of education, there was no central platform to handle this payment, nor were the necessary banking details of the eligible persons available. To be EU-GDPR-compliant regulations were also required from all 16 state parliaments for the collection, processing and transfer of the necessary information to the federal portal. The payment process is scheduled to start mid mid-March 2023. Within a very short time, the central platform[16] was set up under the leadership of the federal state of Saxony-Anhalt.

The BundID (federal user account, eIDAS-compliant) is used to register eligible persons. A sharp increase in BundID accounts is expected. As of Feb. 22, 2023, approximately 407,000 BundID accounts have been registered, including more than 150,000 new ones since the end of January 2023. The eID function of the new ID card has been used by about one-third of individuals to register. ("Über 407.000 BundID Registriert," 2023). Alternatively, for example, the Elster[17] account, which is required for tax declarations, can be used for BundID registration.

In 2021, field tests with digitally verifiable and machine-processable upper secondary school certificates[18] were conducted for the first time in Germany's federal state of North Rhine-Westphalia. Since it became apparent that the Blockchain technology used there did not provide the necessary standards and security that was needed, the project was restarted with a modified technology. In cooperation with the German National Education Platform („Nationale Bildungs Plattform" - NBP, see Chapter 2), the current approach relies on PKI certificates as well as the national data standard XSchule as a first step. Later, this data standard will be converted into the ELMO and ELM data formats for communication with other countries (e.g. cooperation with the Netherlands is planned).

[14] https://www.hochschulstart.de
[15] https://www.gesetze-im-internet.de/eppsg/
[16] https://www.einmalzahlung200.de/
[17] https://www.elster.de/eportal/start
[18] https://www.digiz.nrw/

In addition, a digitization of vocational training certificates is planned via some initiatives such as the „Netzwerk Digitale Nachweise“ (Digital Certificates Network[19])

Register Modernization

The Register Modernization Act (RegMoG) was published in the Federal Law Gazette on April 6, 2021 [20]. The German register landscape consists of more than 375 register types at different administrative levels, in which required information for administrative tasks, official statistics and the census is stored[21]. However, the registers are not systematically interconnected, making it difficult for authorities to retrieve the necessary information and documentation from other registers. The Register Modernization Project aims to coordinate the technical, structural and legal development of all German registers while maintaining a high level of data protection.[22]

The goal is to create a technical system for the implementation of once-only data exchange in Germany and within the EU.[23] In 2021, the essential foundations for a sustainable realization of the target landscape are to be established. In 2022, technical and organizational measures will be introduced and interoperability with the European system will be achieved. Necessary legislative projects will also be driven forward. [24]

4 Infrastructures, Developments and Interoperability

In the OOTS Building Blocks presentation of the European Commission, the differences between the current Cross Border and the Once-Only Principle are described with the following comparison tables:

Today	Once only will
There are different evidences required across the Member States for administrative procedures	Automate the mapping and discovery of evidence types between Member States via the OOTS common services.
Many evidence providers in each Member State and no easy way to know who they are	Provide a EU-wide catalogue of evidence providers via the OOTS common services.
Not easy for administrations to confirm that evidence citizens upload is authentic and up-to-date	Directly connect public administrations with authentic data sources via a secure channel.

Table 1: From (DG GROW, DIGIT, DG CNECT, 2022)

CROB HEI/EDU	OOTS/TOOP HEI/EDU
Governance Structures:	Governance Structures:

[19] http://netzwerkdigitalenachweise.de/
[20] https://www.stmd.bayern.de/themen/digitale-verwaltung/registermodernisierung/
[21] https://www.stmd.bayern.de/themen/digitale-verwaltung/registermodernisierung/
[22] https://www.stmd.bayern.de/themen/digitale-verwaltung/registermodernisierung/
[23] https://www.it-planungsrat.de/projekte/projekte-des-it-planungsrat/registermodernisierung
[24] https://www.it-planungsrat.de/projekte/projekte-des-it-planungsrat/registermodernisierung

- consent/contract/membership	- law/regulation
Provider Structures: - mixed uni/public admin/companies	Provider Structures: - public admin with subcontracting, uni
Security for access and documents: - EMREX/ELMO/EWP, TLS/signature variants (advanced), in future integration of eIDAS/eID and TrustServices (LoA substantial to high, standards)	Security for access and documents: - EU Building Blocks – eIDAS, eDelivery ...
Long time storage security for documents: - proprietary for stakeholders, in future eIDAS preservation services (standards) possible	Long time storage security for documents: - proprietary for stakeholders, in future eIDAS preservation services (standards) possible
central access to portal/service/register on user side and decentral uni offices side integration or central access to portal/service/register on user side and uni office side integration or decentral access to portal/service/register on user side and decentral uni office side integration (DE default)	central access to portal/service/register on user side, user mandates offices to collaborate and exchange his data between offices

Table 2: Status and best practices at EU Member States, and perspectives

Improvements and Proposals

In relation to EMREX & ELMO, proposals to improve security and privacy by design and machine readability/check-ability and interoperability were made at the 2022 EMREX Workshop. Important points were the integration of digital identities of different types, such as EU eIDAS/eID, for the indication of the creator/sender under consideration of Level of Assurance (LoA) and, if necessary, the establishment of interoperability of ELMO signatures with the EU/ETSI signature standards (e.g. XAdes). Another important point was the linking of ELMO/EMREX messages with an additional encapsulation on header level (similar to OSI, SOAP or IPv6 sub headers), e.g. for a trusted EMREX National Contact Point (NCP) (EMREX, 2019) feature search. (Strack, 2022)

TOOP uses the CEF eDelivery building block., which allows to create a network of nodes for secure digital data exchange and the creation of a safe and interoperable channel to transfer documents and data between organizations ensuring data integrity and confidentiality in every transmission through the use of digital signatures and encryption.
This Building Block enable legal assurance and accountability in the exchange of data and documents. As an example, eDelivery mandates that the recipient of a message must send a digitally signed acknowledgement of receipt for every message received (Boldrin et al., 2021). The evidences and receipts can be used for different areas, e.g. the educational area.

The preview requirement of the SDGR indicates that evidence does not simply flow from one competent authority to another upon request. The date must be made available for preview to the user, which implies that it is transferred first to the user (possibly merely as a visual representation rather than a comprehensive file). After the data subject has given consent, the data can be transferred.

The integration and explicit indication of (trustworthy) eIDAS eID data (delivered by eIDAS/eID services) in (then signed) HEI/EDU documents like TOR, certificates or diploms (even in EMREX or EWP today) is currently obviously a future concern, today mainly through copy/paste actions from id services into diplomas or HEI/EDU certificates by office stakeholders are present. Our proposal now is to define a mainly automated process/service, where the ID of the diploma holder is integrated automatically and securely (by standards, like eIDAS eID/TS) into the diploma document, which is going to be signed then by the HEI student office roles, using derived ID services and notarization, like YourCredentials (Strack et al., 2021b) (Strack et al., 2022a) (also interoperable with VC W3C standard in future).

To bridge the gaps between the SSI/(eIDAS 2.)wallet and the OOP/OOTS principles for more interoperability, we propose secured/signed one-way-granting-tickets for (remote registered) TOR, certificates diplomas as default in citizen/student wallets , as well as (signed) receipts for interactions with SDG services/offices.

A challenge for the education systems currently being developed in Europe is their subsequent operation after completion. This is particularly true if these systems are to be flexibly adapted to user requirements. Consideration should be given to the formation of organizational units to provide appropriate governance for system development. A successful example of such an organization can be found in EMREX/ELMO. However, this is self-organized and self-supported by the participants and thus dependent on the members goodwill and willingness to cooperate. It is therefore not clear whether this form can be continued in the future with a strong increase in the number of users or whether another form of organization must be chosen.

A similar governance problem will arise in the future in the area of the data standards used. Here, the de facto standard ELMO used by EMREX and managed by the EUG was for a long time the only standard used in operations. Now other data standards such as ELM (currently ELM preforms are used mainly by Europass), Open Badges or national standards are developing. Even though compatible versions of some of these systems now exist (such as ELMO and ELM - or such are planned, as with ELM and Open Badges), they will continue to be developed in operation. What is missing here is a governance organization to steer this further development in the sense of interoperability between the standards.

5 Conclusion

We gave an overview about current developments CROB vs. OOTS, making some observations:

1. We could observe different approaches in eGovernment implementations (also in HEI/EDU) between SSI/eIDAS and OOTS/SDG.

2. eIDAS/eID is not automatically included for TOR/Diplomas, but sometimes use of qualified electronic signatures (QeS) takes place.
3. A translator between ELMO 1.7 and ELM 3 Europass is currently being developed. EMREX and EWP both already use the same data format basis ELMO.
4. An EMREX gateway providing a converter that shall allow educational institutions, together with ELMO to ELM converter, to make a bridge between federated/centralized solutions and VCs SSI paradigm

Our proposals for future work in these contexts of interoperability:

1. Integrate signed (eID based) IDs/YourCred. in diplomas with explicit sourcing/references
2. Wallets with signed granting tickets/receipts for diplomas – interop. for eIDAS 2.0 wallet, priorization rules for redundant evidences from different sources (e.g. OOTS, wallets).

A future step could be integrating the previously named services into horizontal networks and institutionalising their structures. The network could focus on organizational interoperability, integrating diplomas in the wallets based on eIDAS 2.0, data ownership, data reorganisation and responsibilities, also further security developments for existing frameworks like EMREX/ELMO/EWP are to discuss (e.g. at EUNIS workshops). Next steps could be discussion of integration strategies for provider models.

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Mirko Stanić works at the Agency for Science and Higher Education in Croatia. He has worked in Central Applications Office since 2011 as the lead software developer on the Croatian Higher Education Admissions system (NISpVU2). Since the inception of EBSI he has been a representative for Croatia at the SSI / Diplomas workgroups and is currently involved at EMREX network as a technical officer.

Prof. Dr. Hermann Strack, a full professor for network management and computer sciences since 2000 at HS Harz, also the coordinator for Informatics / E-Administration study course, the speaker of the Competence Centre as well as the head of the Network Laboratory (netlab) and the ICT Innovation Laboratory - SecInfPro-Geo (Security, Infrastructure, Process Integration & Geographical Information Systems), as well as the coordinator of CyberSecurity Network LSA (see https://clsa.de). Furthermore, he is a member of the Gesellschaft für Informatik (GI e.V.) and the Competence Center for Applied Security Technology (CAST e.V.). In 2007 Prof. Strack was a co-founder of the European rs3g-group in Rome - rome-student-systems-and-standards-group (rs3g) - a group which moved to European University Informations Systems as an EUNIS task force in 2009. Prof. Strack has focused his research activities mainly on the conception, the development/implementation of systems in the areas of IT-Security and E-Government. Specifically, he focuses on the development of eID based applications with the identity card in Germany (eID/PA) and eID/eIDAS, namely in the EU CEF Projects TREATS, StudIES+. https://netlab.hs-harz.de/research/ https://studies-plus.eu https://cslsa.de

Arn Waßmann, Product Owner for infrastructure of HISinOne, has been employed at HIS eG since 2008. After his studies he was software developer for HISinOne for 8 years. The focus of his work is building the infrastructures for digitalization of higher education processes in Germany.