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# TABLE OF CONTENTS



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## 1. INTRODUCTION

DC4EU partner ECCA held an effective workshop on 'Standardization in Digital Credentials for Education' at the University of Porto in September 2023. The workshop was organized as part of the DC4EU project task 9.3 'Stakeholder management & Standardization'. The workshop covered aspects ranging from understanding the work being currently done under the scope of various projects and initiatives at both European and global level on the evolution of identification in the education ecosystem, to the relevance of the interoperability at all layers of a digital credential system. It is clear that the joint effort of all the stakeholders involved, spanning from institutions, and governments to service providers and the final end users is required and will lead to the definition of common and agreed standards that will fulfil everyone's expectations, therefore making faster their adoption and deployment in real-life scenarios.

The hybrid event was attended by over 75 people, from 27 countries, who explored the current trends in educational identification in Europe. Presentations included an update from the European Commission & NTT Data on the current status and roadmap of the European Student Card Initiative (ESCI). We then focused on recent projects in Student Identification including EDSSI L2, MyAcademicID and EWP, In addition the European University Alliance for Global Health (EUGLOH) and the International Student Identity Card (ISIC) association presented their views on how they foresee the future as a result of the emergence of digital credentials. Following this, the DC4EU project was presented which focused on the Education Large Scale Pilots and their significance to the ESC and Logalty in Spain, presented on the related standards on digital credentials and their implications for the education ecosystem.

In an Open Panel discussion, there was also time to analyse existing standardization activities, their relevance to the Student ID and the potential use of the European Digital Identity Wallet (EUDIW) for student identification.

It was agreed by all that standardization is the way forward, whilst also embracing the great work already done and not 'reinventing the wheel', and to commit to leverage the opportunities of joining future workshops to share views and ideas.

In the following sections, after introducing the agenda and scope of the workshop, a summary of all the presentations is presented. These presentations gave the floor to an open discussion between a set of experts and the audience, which is included in section 4. Finally, some conclusions and outcomes of the workshop are outlined.

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## 2. AGENDA

The workshop was divided into three sections as follows: Section 1 included the different initiatives and Student ID projects, which provided updates on the work being undertaken; Section 2 was an in-depth description of the current standardization efforts and Section3 concluded the workshop with an open panel discussion involving the speakers and attendees.

Table 1 outlines the Workshop Agenda. After a short introduction led by the organizers ECCA and University of Porto, the European Commission introduced the ESCI goals, status and roadmap. Next, a set of presentations, provided an overview on the updates and results of 5 EU projects and initiatives on Student Identification.

Following this, the DC4EU project was presented highlighting the Education Large Scale Pilots (LSP) and its significance to the ESC.

The final presentation of the workshop showed the relevance of standardization of the Student ID, the future adoption of the EUDIW and the implications of the usage of digital credentials as the main means of identification for students across Europe.

The workshop concluded with a panel session where the attendees shared their views and openly discussed with the experts, raising questions and concerns.

***TABLE 1 :* WORKSHOP AGENDA**

| Start time | Planned duration | Item description | Presenter |
|---|---|---|---|
| **Standarization in Digital Credentials for Education Workshop** | | | |
| **14:00** | 5 min | Introduction and Overview | ECCA and U. Porto |
| **14:05** | 30 min | **European Student Card Initiative 2025**<br>An update from the European Commission and NTT Data on the current status and roadmap | • Mr. Theo Mink, European Commission<br>• Mr. Jeroen van Lent, NTT Data |
| **14:35** | 50 min | **Projects in Student Identification**<br>EWP, EDSSI L2, MyAcademicID, ISIC, EUGLOH | • Ms. Janina Mincer-Daszkiewicz, U. Warsaw<br>• Mr. Tamas Molnar, Humbolt University Berlin<br>• Mr. Joao Bacelar, EUF<br>• Mr. Radek Klein, ISIC Association<br>• Mr. Alexander Loechel, LMU |
| **15:25** | 10 min | Break | |

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| **15:35** | 20 min | **DC4EU Project**<br>Overview with a focus on the Education Large Scale Pilot and its significance to the ESC | Mr. Lluis Ariño, DC4EU Project |
| **15:55** | 20 min | **Standards and their relevance to the Student ID and EUDIW** | Mr. Ignacio Alamillo, Logalty |
| **16:15** | 45 min | **Open Panel Discussion**<br>The potential use of the EUDI Wallet for student identification | |
| **17:00** | **End of workshop** | | |

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# 3. SUMMARY OF PRESENTATIONS

A short summary of the most relevant aspects of each presentation made during the workshop is outlined below.

## 3.1 EUROPEAN STUDENT CARD INITIATIVE 2025

This presentation was given by Mr. Theo Mink from the European Commission and coordinator of the European Student Card Project, who updated the current status of the ESCI, and Mr. Jeroen van Lent from NTT Data, EU contractor to lead and deploy the ESCI solution, who provided a more technical overview of the solutions foreseen.

What started as a proof of concept or pilot under the scope of the European Student Card project (ESC) has now become a larger framework. The ESCI is one of the four flagship initiatives of the European Strategy for Universities[1] (which is one of the priorities of DGC) together with the European Universities Initiative[2], Legal Statute for Alliances of Higher Education Institutions[3] and the Joint European Degree[4] . The ESCI is composed of three building blocks namely: Erasmus Without Paper[5], Erasmus+ App[6] and European Student Card[7]. It is all supported by the Erasmus Charter for Higher Education which enforces the digitalization of all Erasmus activities with the participation commitment of the involved HEIs (Higher Education Institution).

Focusing on the European Student Card project, we are taking into account all stakeholders to deliver the benefits of the new digital tools to students, card issuers and service providers. On the one hand, students will enjoy seamless access to services on-campus and off-campus, with their status easily and real-time verified by any service provider. Alternatively, service providers and card issuers won't need to concern themselves with student mobility and the issuance of new cards, as the ecosystem will be valid throughout Europe.

With approximately 1.9 million active cards on more than 200 HEIs across 16 countries, we anticipate a rapid expansion of the network of users, successfully reaching the milestone set for 2025.

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[1] https://education.ec.europa.eu/document/commission-communication-on-a-european-strategy-for-universities

[2] https://eua.eu/component/tags/tag/81-european-universities-initiative.html

[3] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX%3A52022DC0017#:~:text=A%20legal%20statute%20for%20alliances%20of%20higher%20education%20institutions%20would,and%20physical%20resources%2C%20and%20services.

[4] https://education.ec.europa.eu/news/erasmus-funding-will-test-european-degree-label-and-new-cooperation-between-higher-education-institutions

[5] https://erasmus-plus.ec.europa.eu/european-student-card-initiative/ewp

[6] https://erasmusapp.eu/

[7] https://education.ec.europa.eu/education-levels/higher-education/european-student-card-initiative

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From a technical point of view and within a student mobility environment, the ESC project defines a unique card identifier that serves to identify student cards and validate them, which is known as the European Student Card Number (ESCN). This makes it possible to recognize students on mobility across Europe. Each ESCN and token is registered in the ESC Router, which also acts as the validation service. The most common approach is the ESCN encoded as a QR code in the card or any application which, once validated, proves the identity and status of the student. Besides the token porting, this QR code should include some physical and visual security measures to guarantee its authenticity. For instance, in the case of a smartcard as a token, a hologram is used.

The ESC project's infrastructure is continuously evolving ensuring backward compatibility. A new, revamped and more secure version ESC Router, implementing a scalable data model and a more user-friendly interface has recently been deployed, hosted in DIGI DIGIT Cloud infrastructure. Additionally, the ESC project is also working on new levels of validation schemes, supporting not only online, but also offline mechanisms. In this regard, five levels are defined: holograms, QR code, API validation, chip validation, and full offline validation. Currently, levels 0 to 2 are available, while the definition and implementation of the other two, which are more complex, are in progress.

The project, with the help of their governance structure, is always listening to what the community needs and trying to make the next step forward in the right direction.

Following the pilot project involving a centrally stored ESCN, the project is now exploring how to leverage new technologies and standards to provide the required flexibility for digital credential storage, whether on smartcards or NFC devices. The final stage of the project aims at the integration of the ESC in the EUDIW.

### 3.2 European Digital Student Service Infrastructure

Mr. Tamas Molnar from Humboldt University Berlin presented on the EDSSI Level 2 project. Humboldt University is part of an alliance of ten universities in Berlin that share technologies, services and solutions to offer an interoperable solution to the HEI community.

The European Digital Student Service Infrastructure (EDSSI) Level 2 project builds on the work initiated by the previous EDSSI project by further developing the infrastructure created, in order to expand the EU Student eCard core service platform.

The project commenced almost two years ago, with the aim to create the next generation of eCard systems, moving away from the physical cards and providing interconnection and interoperability at European level.

Fifteen partners are currently working towards demonstrating the feasibility of interconnecting their eCard applications so that they are accessible and accepted at any university. This approach eliminates the need to issue new cards, facilitating the mobility of both students and university staff.

However, the work carried out during the project revealed the heterogeneity of card system solutions. This diversity is observed across various layers, encompassing the technology used,

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the ownership of the solution, and the level of control and involvement in their management and use.

To address this situation, after an exhaustive analysis of current systems, the project tackled the development of NFC solutions and applications to achieve the coveted interoperability. Among these solutions, an application was created that integrates various identification mechanisms, ranging from the simple QR code, compatible with the ESC identifier, to support far more robust solutions like MIFARE DESFire. Authentication using eIDAS was also included. In addition, the project, with the help of ELATEC[8], designed and developed an open source NFC reader system for service providers.

As previously mentioned, the goal of the efforts made was to deliver an eCard management solution or, at least, its fundamental building blocks that can be deployed in any location without the necessity of modifying the underlying infrastructure.

### 3.3 MyAcademicID

The next presentation was conducted by Mr. João Barcelar from EUF, presenting an overview of the outcome of the MyAcademicID project, which was funded as a Connecting Europe Facility (CEF) from 2019 to 2021.

The project was built on the need to establish an identification backbone for students, allowing institutions to ensure that users - accessing the cloud-based infrastructure deployed across Europe for information exchange as a result of other projects like EWP or Online Learning Agreement (OLA) - are indeed genuine students. This is especially relevant when dealing with student mobility.

The project studied several use-cases from enrolment, preparation of learning agreements, notifications, exchange of Transcript of Records (ToR), etc. with the focus set on a likely future scenario. The result revealed that digitizing processes inherent to student mobility is required for the involved e-services to know who it is that we are interfacing with, whether it's a student, is the student identity, and also their academic affiliation.

It was then decided that the target should not be on creating new solutions or frameworks but rather on leveraging the tools already available. Since the primary requirement was identification, eIDAS and eduGAIN offered the necessary functionalities. On the one hand, eIDAS provides a European wide framework for reliable identification of persons, while on the other eduGAIN facilitates the secure transport of student attributes. Furthermore, both can be complemented and interact with other elements like the ESC.

Therefore, MyAcademicID built the bridges between different but already existing services, also defining a Single Sign-On (SSO) authentication proxy linked to eduGAIN or eIDAS to support a single European eID scheme. In this way any student or citizen can link their citizn identity with those credentials, provided during the enrolment at a HEI.

[8] https://www.elatec-rfid.com/int/

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However, it's worth noting that a significant number of educational institutions or countries in Europe are not part of these identification federations. Addressing this issue was the seed of the EDSSI project, which is currently in its second iteration.

### 3.4 Erasmus Without Paper

Ms. Janina Mincer-Daszkiewicz from University of Warsaw presented a review of one of the building blocks of the ESCI, the Erasmus Without Paper (EWP) network to which almost 3500 HEIs are registered.

The logic of EWP follows a distributed and decentralized approach with very few central components (the registry and the registration portal). Data is exchanged directly between the nodes hosted at each institution without relying on a central entity.

The EWP network has been working in production for more than 5 years. The lessons learnt reports that a distributed open network of trust does not always work. It depends on the individual implementation and deployments of each institution, which cannot be controlled and might not follow the interoperability guidelines or the availability and readiness ones. As countermeasures, the project is defining clear technical specifications including a reference implementation and organizing technical workshops where teams can share experiences and discuss challenges.

The current status of the EWP project indicates that most of the component's specifications are in a stable release or approaching a level of maturity close to it. Besides, the European wide unique student identifier, known as the European Student Card Number (ESCN) - to be considered in a student mobility environment -, also used within MyAcademicID, is an integral part of the documents exchange on the network such as Nominations, Learning Agreements and ToR.

The statistics presented on the number of users, approved Inter Institutional Agreements or exchanged Learning Agreements, demonstrate the project as a clear success story.

### 3.5 International Student Identity Card

The presentation on the International Student Identity from the perspective of the ISIC Association was delivered by Radek Klein.

The ISIC Association is a non-profit organization founded 70 years ago in Denmark by student organizations and it is currently composed of over 120 member organizations, of which 39 are in Europe. Their mission is to make life better for the over 2 million students in Europe that possess the ISIC card.

The ISIC card has undergone a journey, transitioning from a paper document to the traditional plastic smart card, and finally evolving into a mobile app, completing its transformation into a fully digital credential system.

ISIC offers access to discounts and services around the world, ranging from museums, language courses, transportation, accommodation, restaurants or discounts in store. The card is the credential required to verify the student's status in order to enjoy these offers.

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At present, as there is no single standard technology in the education smartcard sector, the ISIC card can be embedded in different formats and technologies. ISIC acknowledges that plastic cards will remain relevant for some time, but they have identified that the lack of standardization in terms of technology and data model is a hurdle that needs to be addressed.

The new digital card is available through the ISIC mobile application, but it can also be integrated into the university's mobile app, including the issuance process as a counterpart of the plastic card.

ISIC is involved in the ESCI and its card can integrate the hologram, QR code and/or the unique European student identifiers upon request of the HEI. Nevertheless, ISIC's commitment to facilitating student mobility extends beyond this, and it is currently involved in multiple partnerships working towards that goal.

### 3.6 European University Alliance for Global Health

Mr. Alexander Loechel, on behalf of EUGLOH, an alliance of 9 universities, made a presentation on the work being done in the alliance to turn the ESC vision into a reality. The presenter stated that we all have to share our vision and work towards seamless mobility for students and staff, as well as towards interoperability across European HEI campuses. Interoperable Services and access to those services, for every member in the higher education community (students and staff), are key for seamless mobility as well as for vibrant, multicultural, and inclusive inter-university campuses.

He stated that the ESCI is a great idea which he and EUGLOH fully supports but there are obstacles in the path that make it difficult to deploy and use. These include interoperability, transparency, security and legal perspectives with the currently available and presented solutions. Furthermore, he added that it does not reflect the state of the art in technology of modern credentials.

EUGLOH is attempting to realize the vision of interoperability and security considering them by design, but also respecting current legacy systems and working with the state-of-the-art technologies, including chip cards, smartcards, and smartphone wallets, without 'reinventing the wheel' by building own standards.

It was understood that although plastic chip cards and smartcards are currently the most common token solution for transporting user's credential and their attributes, they are not future-proof solutions. They suffer from incompatibility issues due to many standards, limited memory and they can be costly. These limitations can also be extended to apps on the mobile phone, which suffer from similar flaws. Additionally, users must integrate their phones into the HEI system (installing applications, etc.) rather than the system adapting to their device. Smartphone wallets disrupt the token medium market, NFC enabled passes in wallets are much more flexible than integrated smartcards. Bring your own device, becomes the norm for future credentials. The systems must adapt to users' devices, which follows the shift with digital transformation from organization-centric optimizations to user-centric optimizations. Convenience for the users is the key to the adoption and success of the ESC vision, but it must also meet the needs of security and trustworthiness of the service providers.

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With “smart select”, the capability of a reader to tell the smartphone which pass he wants to read, a wallet is more than a container for a bunch of cards, it can actually replace integrated cards, without binding all passes to the same underlying technology standard, e.g. vendor specific protocols or host card emulation.

In the long run, interoperability also depends on the systems. Replacing all legacy systems at HEIs, is not feasible within short time periods, so modern token mediums must be backward compatible. Hence, the answer to interoperability lies not only in the token itself but on the reader side. Most readers can support multiple smartcard technologies; it’s primarily a matter of updating the control software to read a token medium and map the dataset structure stored to the one used in the backbone systems. It’s evident that security and privacy are truly enforced by corresponding technologies. Depending on the service different technology can be chosen to implement the security and authentication needs of the service provider. Different levels of authentication, dynamicity, and security are provided, which is in line with what EUGLOH prioritizes, going far beyond the simple validation level 0-2 of the ESC, of just a hologram or a static QR code.

eduTAPs seeks to enable a smooth transition from legacy tokens into smartphone wallets, by splitting the functionality into single use-case passes for dedicated services and one additional common ID pass, based on the generic ISO/IEC 18013-5 data structure, that reflects the common educational attributes used in eduGAIN, the inter-federation of Authentication and Authorization Infrastructure in HEIs around the world.

eduTAP, the solution EUGLOH proposes, is to the on-site world what eduGAIN is to the online area. EUGLOH is working closely with the users (students, faculty members, and staff) trying to understand their needs and the way they usually interact with services on and off campus.

eduTAP will provide agnostic, open-source frameworks and white-labeled portals and applications to help issue passes by HEIs and service providers as well as for the most common task in the educational workflow to read and process passes.

In summary, EUGLOH is leveraging well-established and widely deployed solutions and provides software to issue, read and process passes. This approach enables higher education institutions to explore and assess various options, allowing them to determine the most suitable solution for their specific environment. Building on top of smartphone wallets also enables the users (students, faculty members, and staff) to receive and use such passes to access services in a known way.

### 3.7 DIGITAL CREDENTIALS FOR EUROPE

Mr. Lluis Ariño is the coordinator of the Work Package 5 of the Digital Credentials for Europe (DC4EU) project. His presentation provided an overview of the work being done in the project and the LSP on digital credentials in the education ecosystem. Considering his extensive knowledge of European identification and digital credentials, he also offered insights into the roadmap and standardization efforts the EU is pursuing.

The presentation included a review of future eIDAS requirements, which focuses on empowering citizens, providing them with the means to own, control and manage their

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credentials. By using their wallets (common toolbox), citizens will control what personal data and to whom it is disclosed, and how and when is shared.

The DC4EU project is part of the EU Commission's efforts to evaluate different use-cases in the context of large scale pilots. DC4EU primarily focuses on two use-cases: education and social security. Additionally, three more projects (POTENTIAL, EWC and NOBID Consortium) have been funded and will work on other use-cases within both the private and public sectors.

Considering the educational use case, DC4EU will work on the issuance, usage and sharing of credentials, professional qualifications, titles and licenses. DC4EU is confident that the wallet (EUDIW) will be the container of the individual learning records, etc., but also the bridge between existing services and solutions based on state of the art technologies, centralized or federated, towards a fully decentralized environment.

The DC4EU project will build its solutions on the work already achieved in the context of European Blockchain Service Infrastructure (EBSI), and in the educational use case involving the leverage potential of digital credentials, as well as the eIDAS framework and the EUDIW Architecture Reference Framework (ARF). The objective is not to replace what exists, but to provide another paradigm on how to consume credentials whilst guaranteeing each citizen control over them.

Under the scope of DC4EU (WP5), the main tasks can be summarized as follows. Initially the project will gather information from the educational ecosystem, mapping and aligning their requirements to the ARF. All types of education (formal, non-formal, informal) at all levels (primary/secondary/tertiary/adult/up & re-skilling) and professional qualifications will be covered and analysed.

Then, DC4EU will deploy real user journeys involving multiple institutions, which will lead to real testing of the EUDIW. As a result, feedback and improvements to the EUDIW will be provided and re-tested. Additionally, dissemination activities will facilitate the establishment of connections with key stakeholders in this business domain.

The project will align with other existing services in education by providing translators, gateways, etc. to interact with them. In this context, Verifiable Credentials will act as a container of users' information, but they need to be defined and sustained on a rich data model that properly describes users' attributes in the various scenarios, along with a protocol that facilitates the exchange of information between entities, as it's being defined in the ARF (W3C-VC, VCDM1.1, JSON, SD-JWS, StatusList2021) based on EBSI pillars.

All of these solutions are designed with the user as the central figure, ensuring that they have control over their own data.

### 3.8 STANDARIZATION IN DIGITAL CREDENTIALS

The presentation by Mr. Ignacio Alamillo from Logalty, complemented the previous presentations by providing an overview of the standardization work and the issues we are

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facing. Logalty is involved in the DC4EU project, leading the identification of the legal aspects relevant under the scope of the project.

In this sense, eIDAS 2, as the cornerstone the new European identification ecosystem, defines three legal regimes, set of rules or trust models, as follows: EUDIW, (Qualified) electronic attestations of attributes ((Q)EEA) and Electronic attestations of attributes issued by or on behalf of a public sector body (EEAPSB). These rules have been directed towards addressing the shortcomings of the current regulation, supporting a distributed and decentralized environment where identities are not limited to citizen identity and where the users can easily exchange their identity attributes with legal effect. Trust, electronic attestation of attributes and verification of data are some of the characteristics this new ecosystem will provide, not requiring governmental institutions to be always in the loop. EUDIW, mobile or not, will have a close liaison with (Q)EEAs and EEAPSBs according to different management approaches.

But these regulations have to be mapped to technological and operational specifications using, -whenever possible- existing or newly developed standards and later criteria that have been developed and properly tested. In this sense, uniform and harmonized conditions for the implementation are defined under what are known as Implementation Acts.

To this end, the EU Commission proposed the creation of a toolbox, the ARF, which contains a description of all the actors and how they participate in the EUDI Wallet ecosystem. As already mentioned, it defines a new method to move personal data with full control of the citizen and special emphasis on GDPR restrictions.

In this sense, the specification, in order to meet the imposed requirements, contains mechanisms, data formats and procedures based on specific standards. Two types of configurations are defined: one more strict that adheres to public laws designed for personal identification data, while the other is more open, providing lower levels of assurance. Technologies or solutions like JSON, JWT, Linked Data, etc. are considered.

However, when considering the proposed standards to be used, such as the ISO/IEC 18013-5 mDL international standard, it is worth noting that it may not cover all the required capabilities, and its semantics, procedures, data structures, etc., are not necessarily tailored for the specific use cases and scenarios involved. In some cases, these standards may not even be mature enough to be considered the right option for the future.

In the opinion of the presenter, the work done to issue the ARF is indeed valuable, but certain parts of the ARF are still far from being standardized. This leaves room for improvements and contributions, which is the purpose of the LSPs, whether by modifying existing components or defining new ones. It is crucial to conduct thorough testing of the decentralized trust supported by the EBSI as the verifiable data registry, and to ensure that the support for different credential approaches meets the requirements of eIDAS 2 for the educational community.

Nonetheless, time constraints exist, but it is essential to take measured and steady steps in the future and consider what already exists, such as identity federations and cloud wallets, which remain valid and can be extended to support our needs.

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# 4. PANEL SESSION DISCUSSION

Following the individual presentations, where we delved into the status of the education ecosystem throughout Europe, by introducing the most relevant projects and initiatives, along with their related standards, the workshop then focused on a discussion among all the attendees.

A number of speakers were invited to join the panel considering their relevance to the scope of the workshop topic. These included Mr. Jeroen Van Lent, representing the ESCI (an initiative of the European Commission); Mr. Lluís Alfons Ariño Martin, representing the DC4EU Project (also a valuable contributor to many working groups and committees on educational credentials); and finally, Mr. Ignacio Alamillo, an expert in the standardization of eIDAS v2.

Initially, the discussion focused on the ESCI, together with the European Commission, they are defining the path towards a global European student credential and its initial deployment. It is planned that in 2025, an initial version is to be available and working in Europe. However, some speakers expressed their concerns regarding time constraints, but also on security, compatibility, and interoperability issues with existing solutions. So, the question put to the panel pointed out the fact that it won't be easy to ensure every institution is 'on board' and therefore achieve the stated goals.

Mr. Jeroen Van Lent addressed this question, and his response indicated that everything is evolving as expected, and they are applying the lessons learnt from previous projects. He outlined the project is on the right track and the figures reveal the efforts of the ESCI and EU are achieving and even exceeding the initial objectives. The approach of starting by using a hologram and a QR code, while not the most secure solution, is readily applicable to smartphone applications, which as some point in the evolution, is making it appealing and user-friendly for both students and institutions. He further stated that, on the other hand, Service Providers, who are ultimately responsible for developing and providing the solutions, can quite effortlessly integrate this in their ecosystems.

The discussion indicated that the main drawback is that it seems that at present staff (teachers, administrative personnel, etc.) are not part of the process. It is a fact that mobility and access to on-campus and off-campus services is not restricted to students. Therefore, we have to enforce that the final outcome covers all the members of the educational community, including staff members. In this sense, it is considered that their situation is quite similar to that of the students and thus there will not be major problems engaging them at any moment in the future.

One of the most important aspects the ESCI is working on is the cultural shift of being part of a global technology that is usable anywhere across Europe and that makes mobility a reality. Nowadays, even though mobility is fully accepted and integrated into our lives, there are still difficulties in acknowledging everyone is part of the system and that by using one simple token, holding your credential, you will have seamless access to services in a similar manner as at your home institution. It is then agreed that once we make this cultural shift, extending capabilities and functionalities will be quite straightforward.

Taking up the baton left by the previous discussion, where mobility was considered a key point in the definition of a European student ecosystem, the discussion continued in relation to the

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question regarding which technology or technologies will enable the secure transport and exchange of information among the stakeholders. Smartcards, phones, wallets, decentralization, traceability, etc., have been mentioned during the workshop, but this has not yet been narrowed down.

Mr. Lluís Alfons Ariño remarked that technology is just the enabler, but that as previously mentioned a cultural shift, new standards definition and compliance commitments, laws enforcement, etc. are some of the additional parameters that have to be taken into consideration to solve the problem properly and successfully.

Nevertheless, from a technological perspective, Distributed Ledger Technologies (DLT) and the deployment of the Self-Sovereign Identity (SSI) seem to be the real alternatives to act as the trust anchor, formatting schemes and procedures for the exchange of information between the different stakeholders. In this sense, the already deployed and tested infrastructure provided by EBSI is to be used during the first stages of the implantation of the new digital credential ecosystems.

Both Mr. Lluís Alfons Ariño and Mr. Ignacio Alamillo agree that the DLT will provide trust in such a way that it acts as a verifiable registry that can be used by anyone. Furthermore, it enables validation of the truthfulness of the information without the involvement of the issuer, which contrasts with the solutions currently in use, which, by involving the issuers, provide them with transaction information consistently.

The panelists emphasized the importance of understanding that the DLT is not a storage system. The data, following GDPR regulations, is to be under users' full control, with them being the ones that store and decide with whom their information is shared.

Therefore, once we agreed that we have the means to enable the trust, we need new methods to encapsulate and distribute it transparently and support its verifiability. Verifiable credentials are foreseen as the common and interoperable container that encapsulates the information in the form of assertions, as it is technically known. In this sense, they support abstract data models and formats, which, in turn, opens the possibility to packaging any kind of information.

Consequently, it is essential to define or utilize common taxonomies that allow for the potential creation of a shared understanding of the terms used to describe user assertions or claims, facilitating the establishment of connections between various sets of information. In doing so, we can promote interoperable deployments, fostering the cooperation and interaction between heterogeneous systems that we all seek.

Whilst the digital credential, including as a key attribute the unique student identifier defined under the scope of the ESCI or the PID defined within eIDAS v2 ecosystem and wallets, acts as the transport container, it is not the sole option. Instead, we should explore various alternatives, both in cloud and online networking environments (mainly used for inter-institutions communications) and in the immediate, physical, face-to-face interactions (mainly used in local exchanges between users and Service Providers), analyze their potential, test them, and then determine the most optimal one. What may appear to be the wisest decision today could turn out to be a mistake in the near future.

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As recommended, we don't have to limit ourselves to only the most cutting-edge solutions. We can make use of the existing pieces of technology to initially address the current needs and problems we face. It is advisable to also look to the future and experiment with emerging technologies and standards. Some of these may be in a draft stage and ultimately get rejected, while others will evolve and become part of the pool of potential usable technologies. It is also important to understand that technologies can change, emerge, and disappear, but the goal of the European student credential and solving student mobility will remain relevant for many years.

Educational institutions may need to invest in order to keep up with these developments, but we can't force them. It is recommended we should provide them with alternatives that are compatible with the technologies and solutions they already have, while encouraging them to progress in order to access new value-added services.

In summary, it was agreed to be ambitious but be mindful and consider that we have to adapt the solutions to the potential users' capabilities. It was also outlined that we need to agree on the container for information exchange, on the ontologies and taxonomies to describe that information, and on the protocols to properly exchange everything. The latter point is closely dependent on the technologies used, so a thorough analysis and testing of different solutions should be performed.

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# 5. CONCLUSION

This workshop on 'Standardization in Digital Credentials for Education' revealed the relevance and interest of the community (both European and global) on both the future of education identification and the standards that will sustain an interoperable ecosystem. Over 75 people from 27 countries participated, and they learned and shared their experience on the topic.

Initially the EU commission representatives introduced their vision and the work currently carried out within one of the four flagships initiatives of the European Strategy for Universities, the European Student Card (ESC) project. With more than 1.9 million cards and new HEIs joining the network of users, they presented an adaptable solution from the technological and security contexts. However, the currently most adopted solution for identifying and verifying the students, a ESCN encoded as a QR code, was somehow considered controversial even if it fulfils the interoperability and globalist objectives. However, the project is exploring the deployment of more robust platforms.

There were many projects on the future of educational identification in Europe presented at the workshop, some currently in progress and others in completed form. Projects such as Digital Credentials for Europe (DC4EU), European Digital Student Service Infrastructure (EDSSI) level 2, Erasmus Without Papers (EWP) or MyAcademicID, and associations of the European University Foundation (EUF), the European University Alliance for Global Health (EUGLOH) or the International Student Identity Card (ISIC) demonstrate the efforts made at European level to succeed on the creation of an interoperable digital credential ecosystem.

The solutions presented ranged from hardware to application definitions, from data models to the methodologies applied for the exchange of information, from inter-institution interaction to service providers' interactions with users. However, all of them share a common idea, namely that standardization is the way forward, and that we should look to the future without overlooking what has already been achieved and is currently being used. It is not clear the best way to proceed, as in order to succeed, there can be one or multiple directions, but this is the reason why all these initiatives are in progress and working towards a common goal

This joint effort will not succeed if all the stakeholders involved, spanning from institutions and governments to service providers, don't have a common approach. It is not only about the data model and the protocols. It is also about the containers and providing the best user experience to fulfil everyone's expectations. It is not only about standards, but also the technology we will put on top of them. It is not only about security, but also about users being under the control of their data. Many open questions still need to be solved and the 2025 deadline is approaching quickly.

In this sense, following a bottom-up approach, NFC interoperability not only on the technology used but also on the data structure will increase the competence in the sector, allowing seamless transition from one service provider solution to another. On the upper layer, it has been already

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proven that open source solutions and standardization is the way to proceed. eIDAS, eduGAIN, etc. are clearly successful strategies.

DC4EU is taking a different approach from what was depicted by other projects, leveraging new Distributed Ledger Technologies (DLT) and the Self-Sovereign Identity (SSI) paradigms. It considers not only HEIs but also the complete educational range. DC4EU Large Scale Pilots (LSP) and will demonstrate how the EUDI Wallet will bring together and harmonize some of the current efforts whilst developing more robust services.

The general consensus is that further discussions such as this workshop are necessary. This workshop focused on projects and institutions but a similar event involving service providers is fundamental in order to assess and analyse their views on the future adoption of standards, as they are the ones working on providing solutions to the end users.

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