

Title

New paradigm for education: verifiable digital credentials; gaining real interoperability while really empowering students/citizens

Author names

Lluís Alfons Ariño Martín¹
Universitat Rovira i Virgili, Spain
lluisalfons.arino@urv.cat

Abstract

The educational system has been hit by the COVID-19 pandemic, far from being a threat, can be an opportunity to eliminate the real threat, the necessary transformation of the educational model, accelerating this transformation towards a model that expands the current one by introducing an orientation to skills and skills that respond to the demand of digital society , with the characteristics and values of the European Union.

A key point for Europe's own transformation is the accreditation of educational achievements and the possibility of verifying in real time the provenance, the integrity and veracity of issued digital credentials.

This work will set out the model that the European Commission itself and the Member States have made available for the accreditation of educational achievements, effectively enabling lifelong learning, personal paths of learning, the aggregation of credentials, as well as the mobility of both the identity and the student record.

Beyond accreditation, this new paradigm enables an opportunity to standardize interoperability in interaction with digital services, while fully empowering the citizen, who takes real control of both their identity (identities) and their data, thanks to self-sovereign identity.

¹ <https://orcid.org/0000-0002-2310-6911>

Digital Credentials

What are Digital Credentials?

In a simple way, we can define a digital credential in the educational context as the accreditation of an educational achievement by digital means, which allow to verify both the integrity of the information contained, as well as the issuer of the digital credential, and the recipient to which it has been credited with such educational achievement.

When we talk about educational achievement, we say it broadly. The data model, the so-called Europass Learning Model, allows to describe any type of educational achievement:

- accredited and uncredited education
- formal, non-formal education, competencies, skills, activities, microcredits, etc.

It should be noted that in the European Union's Data Strategy, it urges Member States to have a digital credential strategy by 2022, and explicitly mentions the Europass digital credential model.

No doubt, the accreditation of educational achievements through digital credentials will play a key role in the new European Education Area (announced in September 2020), facilitating the mobility not only of identity but also the accredited file of the student.

In addition, digital credentials will bring great value to the productive sector by being able to validate by telematic means the information provided to employers, with the consequent reduction of time and fraud.

Technology is evolving rapidly and is transforming entire sectors of society, producing significant changes around accreditation in the education sector, as the needs of the workforce have changed dramatically. In this sense, digital credentials open new paradigms and paths in learning, in which the degrees obtained in colleges and universities will be one of the many paths to successful careers. Change will affect all areas, from colleges and universities to employers.

Learning will be at the heart of evaluating and defining credentials, and technology will promote transparency in achieving educational achievements. Students and citizens would acquire skills, knowledge and skills, and therefore institutions must demonstrate results in the delivery of knowledge and skills.

Educational institutions have the challenge and opportunity in this new paradigm of:

- Measuring learning-based progress as opposed to the traditional credit hour-based model
- Produce high-quality learning outcomes
- Provide lifelong learning opportunities for a student/citizen

What are digital credentials advantages?

Standardizing the format in which we describe educational achievements makes recognition much easier, as the company or institution to which the student shares the information will know how to interpret it semantically and, therefore, it will be much easier to identify and assess the merits (knowledge, competencies or skills) of the student or citizen.

Interoperability, in this sense, is one of the largest values provided by digital credentials. Digital credentials can contain a wide range of valuable information to facilitate their recognition and interpretation by companies and other institutions.

The fact that the credentials are digital and that they are aligned with the current regulation both at the privacy level (European GDPR framework) and identity (European EIDAS framework) attributes the following basic properties to them:

- Integrity: ability to identify that the content of the accreditation has not been altered/manipulated
- Source: ability to uniquely identify the issuer of credentials
- Cross-border value: cross-border recognition of the credentials accredited when signed with an electronic seal, making them equivalent to the printed credentials containing the same information.

In addition, the digitization of credentials contributes to the reduction in the workload of current processes, thus benefiting both stakeholders (students or citizens) and the third parties involved, whether accrediting bodies or companies, who receive and must verify the validity and validity of the accreditation.

The latter point, that immediate verification of accreditation which can be done by electronic means, also reduces fraud, which is no less. In this sense, third parties to which digital credentials are shared can automatically verify various information contained in the credentials, such as the identity of the entity issuing the credential or the quality assurance of the qualification itself.

Last but not least, the elimination of paper also contributes to the collective challenge of sustainability.

Europass EDCI

What is Europass Digital Credential Infrastructure (EDCI)?

Europass Digital Credentials Infrastructure (Europass EDCI) is a set of tools that respond to a strong commitment by the European Commission to European internationalisation and mobility, as an engine of innovation, competitiveness, and excellence.

Part of the tools responds to the evolution of the old Europass documents, which have already provided a first avenue for standardization, interoperability, and mobility. Now, all this is accessible online through the new Europass portal, where each citizen/student can keep such documents "alive". But the new Europass is much more than that, it is also a point of union between employers and jobseekers, saving differences and to understand us it functions as a "LinkedIn" European, where citizens can share which parts of their Resume they want to make visible to third parties (employers), or what job offers they want to receive notifications

based on their personal interests, all with full control over the granularity and characteristics of the exposure/sharing of information.

Europass has a great advantage, and is the provision of a universal validator of digital credentials in order, in this way, to be able to verify the accreditations received that a citizen can share with an employer or an educational institution to accredit learning prerequisites. And this, as we mentioned above, with total cross-border legal value and with the differential advantage of the digital credentials that the portal allows an employer to check both the integrity of the information presented/shared, as well as the identity of the issuer, with the consequent reduction of the possibility of fraud in the curricular information (whether formal or non-formal).

What will Europass EDCI mean for students?

Clearly, Europass es open a first door to the student towards the ecosystem of internationalization, in a first contact with the field of mobility, and to employability with access to an international labour market. In this sense, it is one of the elements to enhance competitiveness.

Europass is also one of the gateways to the great Erasmus+ European mobility program, which aims and enhances mobility, internationalisation, and competitiveness.

For students it is also an easy way for students to become aware of the importance of controlling and managing their own data, learning to share the information strictly necessary for the purpose to be achieved, and thus strengthen their digital privacy.

When will Europass EDCI come true?

The best thing about Europass EDCI, as mentioned above, is that it is already a reality today. The solutions of issuing accreditation of educational achievements and verifying them, are already fully available both in web application mode and through standardized exchange files.

The pilot led by the Directorate-General for Employability (DG-EMPL) of the European Commission, started two years ago, and Spain entered the pilot phase along with 17 other countries.

Specifically the representation of Spain, materializes with representatives of the Ministry of Universities and the Conference of Rectors of the Spanish Universities (CRUE Universities), together with the National Center for Internationalization, SEPIE.

CRUE Universidades started a pilot of 11 universities (Universidad Alfonso X, Universidad de Alcalá, Universidad Carlos III, Universidad de Castilla La Mancha, Universidad de Granada, Universidad de La Laguna, Universidad de Málaga, Universidad de Murcia, Universidad Politécnica de Valencia, Universitat Rovira i Virgili, Universidad de Sevilla), which are already modelling different educational achievements to accredit from activities, to their own degrees.

This year, in addition, the set of facilities made available (APIs) will be released in order to make telematic integrations from the different information/academic management systems or learning environments (LMSs), available to different educational entities.

It is worth mentioning that Europass is constantly evolving, and it is precisely now evaluating the integration of Europass with another of the great European projects of this decade of digitalisation, such as the EBSI (European Blockchain Service Infrastructure) pan-European blockchain services project, which extends the digital credential model to so-called verifiable digital credentials," which will provide Europass with the layer of trust in broadcasting sources, through the so-called Trusted Issuer Registry records, which opens up a new paradigm in the issuance, sharing and verification of digital credentials, empowering the citizen/student, the latter being the one who takes full control of their identity and data. This is another project in which CRUE Spanish Universities also participates to which we can dedicate another monographic, once the alignment project between Europass and EBSI is already public.

What is a reality today is Europass. So there are no excuses not to give a differential value to our students (primary, secondary, higher education, adults) by issuing them and introducing them to the current paradigm of digital credentials.

EBSI

What is European Blockchain Service Infrastructure (EBSI)?

In 2018, 27 EU Member States, Norway and Lichtenstein signed a declaration creating the European Blockchain Partnership (EBP). The EBP assist the European Commission in establishing a European Blockchain Services Infrastructure (EBSI).

The EBP declaration complements the Tallinn Declaration on eGovernment. This political declaration, signed by Member States and EFTA countries in 2017, reiterates the importance of having efficient and secure digital public services in order to achieve the full potential of the Digital Single Market. In the Tallinn Declaration, European governments and EU Institutions set themselves the ambition to provide digital public services matching the current level of digital progress that our society is undergoing. Consequently, Public Administrations must build new capabilities or modernize existing ones using the power of digital technology.

On 14 February 2019, the European Commission published the 2019 Telecommunications Work Programme of the Connecting Europe Facility (CEF) creating initial funding conditions for the European Blockchain Services Infrastructure (EBSI).

EBSI is a joint initiative to deliver EU-wide cross-border public services using blockchain technology. The EBSI will be materialized as a network of distributed nodes across Europe (the blockchain), leveraging an increasing number of applications focused on specific use cases. In 2020, EBSI will become a CEF Building Block, providing reusable software,

specifications and services to support adoption by EU institutions and European public administrations.

The Member States will operate EBSI nodes at national level. These nodes will be able to create and broadcast transactions that will update the ledger. The architecture of each node will be composed of two main layers:

- A layer of Use Case-specific APIs developed to enable business applications to interface with the node.
- An infrastructure layer with capabilities common to all Use Cases. This layer will include generic capabilities and connectivity to Blockchain networks.

Four use cases have been selected for 2019. For each use case, at least a Member State led and composed user group has been established. One of the use cases selected was on the educational domain, it is the so called Diploma Use Case.

Regarding to the policy and governance domains, one of the major challenges for blockchain real adoption is the absence of robust governance mechanisms for nontechnical issues, this will inhibit global adoption of public blockchain. Fortunately, this has been a priority since the beginning for the European Commission, and that is the mandate for the EBSI' Policy group

Diplomas Use Case

First of all it is necessary to remark that Diploma Use Case's scope is not just restricted to higher education, the Diplomas vision scope worked together with all MS in the use case, fixes the scope for long-life learning and special sensibility communities (like refugees).

In the technical domain the fundamental steps have been defined (and let me say that some key aspects have been boldly performed by a great professional development team), and for the Diplomas use case there are three key disruptive technologies that will disrupt the way how education is achieved: blockchain, self-sovereign identity, and verifiable credentials. The combination of these three technologies will bring to education a new paradigm that we should be able to translate to opportunities (personally I think that we are in a key moment for education and we MUST to catch all the opportunities).

Of course, we need the voice of all interested parties, so stay tuned for the next stakeholder meeting planned for January.

Diploma UC outcomes

EBSI Diplomas UC will bring us the opportunity to reduce Diplomas fraud, empower citizens with the ownership and the control of both, their identity and their data, will also facilitate cross-border students mobility, and will enable real lifelong learning for all citizens. This new paradigm places the empowered citizen in the focus, so as public service providers we must raise up the vision on how we provide services in a more transversal way, building the citizen' life journey complete, independent of the actual siloed service providers that in the best of the case build the citizen journey for their own competence of activity

Diploma UC Opportunities

EBSI Diplomas UC will also bring consensus on how educational information is packaged and transported in this network of trust and, together with another big European educational initiative like Europass, the education world has now three big opportunities:

- The first one, is the opportunity to standardize the description of the education itself (for formal, non-formal and informal education), to make educational interoperability a reality.
- The second opportunity is to change the model on how the achievement of learning is being done, by gaining and stacking credentials. This will also open the door to a real implementation of lifelong learning and mobility, and it is a clear way on how other great European initiatives, like the just announced *European Universities* initiative, can be easily implemented.
- Last but not least, it is the opportunity to align the educational credentials with other European initiatives to give value added to the Diploma itself, or to empower the industry improving company's employees' skills, closing the gap between education and employment mapping the educational contents with the employment skills defined by the European Skills, Competences, Qualifications and Occupations framework (ESCO), or the Digital Competences Framework (DigComp).

In addition, this UC will also allow to deepen in the expected outputs from the administrative procedures (specifically related to education) that are identified in the *Digital Single Gateway Regulation (EU) 2018/1724*, from just a mere acknowledge of study's application receipt to help with the process itself.

The challenges

The Materialization

To become a reality some things must also be done in the non-technical domain and out of the EBSI scope itself. This is a challenge for the European Commission, because EBSI will empower the citizen putting the focus of public services on her/him, and there is a need to create a transversal vision of education for all the whole citizens life. So the challenge is to create this citizens' lifelong learning journey on a transversal way in a joint effort between the main different DGs involved, like DG-EAC, DG-HR, DG-EMPLOYMENT and, of course, DG-CNECT with EBSI as an enabler and a facilitator.

The Member States

Member states need to start working also on a transversal way, drawing the actual situation (the as-is) with all the stakeholders, how do they relate today, identify the friction points with the citizen for identity, GDPR, or data transfer, and start to draw the "to-be" putting the citizen in the focus with the ownership and control of her/his identity and data.

To be a reality the Member States will also require some help for the adoption of EBSI. EBSI has been defined to respect the different models of governance of the Member States in each domain, like the Diplomas domain, but the Member States and the different stakeholders will need to interconnect the existing information systems and services under this new paradigm, and some help should be provided there to ensure that EBSI, this high speed highway for the digital economy, will be fully used by all Member States. This is also a joint challenge for both, the European Commission and the Member States.

ESSIF

European Self Sovereign Identity Framework (ESSIF) provides the underlying verifiable credentials capabilities to enable the Diploma Use Case.

What will ESSIF provide / pursue?

- Empower citizen in the management of their data via SSI
- Stimulate the SSI-transformation of public services
- Facilitate cross-border interaction with SSI
- Make/keep national SSI projects interoperable
- Integrate/align existing building blocks such as eIDAS, e-delivery, once-only with SSI
- Conceptualize and build an identity layer in the new European Blockchain Services Infrastructure supporting the current use cases
- Preserve European/democratic values in the implementation of Self Sovereign identity
- Stimulate SSI development and standardization on global level (W3C, DIF, ISO, CEN-CENELEC, etc.)

Basic ESSIF concepts

Decentralized Identifier(DID)

The Decentralized Identifier, or DID, is the key element that will let entities (and by entities we mean natural persons, legal entities, or things) to interact with services provided by other entities. Let me remark that one entity may have more than one DID, and it will be the owner who will choose with which specific DID wants to interact with other entities (thus to avoid profiling), also I will remark that that a DID by itself says nothing about its owner, because it is just an identifier, it is not an identity.

Once an entity has a DID, different data in the form of verifiable attestations provide by 3rd parties can be linked to it. Some of those verifiable attestations may describe the DID owner's identity and others may be just data issued to DID owner.

Finale reminder on SSI paradigm: Identities and data will be controlled, stored and managed by the DID owner.

ESSIF Onboarding Service (EOS)

Once the DID concept has been introduced, let us introduce you the service that will help natural persons, legal entities or things create and get the DID: It will be the ESSIF Onboarding Service (EOS) acting as a Trusted Registry Authority

It is important to remark that EOS must be conceived as a function, and the function can be executed by different actors offering EBSI services

Trusted Issuer (TI)

A Trusted Issuer is a Legal Entity that is accredited to issue certain types of Verifiable Credentials. This sentences clearly start to locate this actor, this role, in the domain use case layer.

To become a Trusted Issuer a legal entity will require authorization from another accreditive source that will "accredit" the requesting legal entity to issue certain types of Verifiable Credential (VCs). In this sense, "accreditation" just means "to make authoritative, creditable, or reputable".

We can identify two different types of Verifiable credentials that trusted issuers may issue:

- Ones used for identification or authentication in a narrow sense
- and other ones used as evidence of attributes or properties NOT mainly used for identification or authorization

Trusted Accreditation Organization (TAO)

A Trusted Accreditation Organization, is the legal entity that will let other legal entities to become Trusted Issuers, it is the source of authority.

Who will be a TAO? Each use case will instantiate TAOs according to applicable domain legal rules.

A legal entity will also require an authorization to become a TAO, that's why the so called TAOR Admin exists, and it may be domain specific authorities, even region or jurisdiction specific. It will depend on the use case.

Verifiable Credentials

Digital credentials + near real-time verification = Verifiable Credentials

Diploma UC v2

Basic concepts

Brief summary of basic concepts and ideas related to blockchain and Diplomas Use Case

- Regarding to identity:
 1. Remember that the identity is based on the European Self Sovereign Identity Framework (ESSIF)
 2. The Decentralized IDentifier, or DID, is the key element that will let natural persons, legal entities, or things interact with services provided by other entities in a narrow sense.

3. It should be highlighted that one natural person, legal entity, or thing, may have more than one DID, and it will be the owner who will choose with which DID wants to interact with other actors (to avoid profiling), and that a DID by itself says nothing about the owner, because it is just an identifier.
 4. Once an entity has a DID, different data in the form of verifiable credentials can be linked to it, that will let the DID owner provide additional information when interacting with others. Some attributes may describe the DID owner's identity, and some attributes will be data issued to DID owner, and they will be controlled and managed by the DID owner.
- Regarding to the data:
 1. Just a reminder; this new paradigm will fully empower citizens, so they will gain full control and management of their identities and data
 - Regarding to Blockchain:
 1. EBSI is a public permissioned Blockchain, that means that everyone will be able to read/check but only the authorized entities will be able to write, so a governance model is required (and clarify governance for Diplomas Use Case is the main goal for today's meeting)
 2. What will be stored on-chain? No data – no Diploma contents - will be stored on chain, but the fact itself of the Diploma issuing will be

Last but not least, given that the citizen has full control of their identities and data, they will always be the origin of any interaction, and explicit consent will always be required to share or accept data. In this sense the GDPR is addressed by design.

Legal aspects on identity and data

Identity

The analysis must differentiate between Verifiable Credentials (VCs) used for electronic identification (Verifiable IDs) and other VCs (Verifiable Attestations or Verifiable Mandates).

Current eIDAS only defines “levels of assurance” for Verifiable IDs.

- Only Verifiable IDs with a LoA substantial or high must be accepted by Member States.
- Verifiable IDs with a LoA low may also be accepted on a voluntary basis, according to the corresponding national legislation applicable to e-Government processes.

Data

Verifiable Attestations typically embody juridical acts, such as certifying acts by public authorities and other authoritative sources (including private sector bodies with respect to data they're authoritative for). Therefore, in the logic of eIDAS, they constitute legally binding electronic documents, that should be authenticated according to the national legislation.

Governance

This is a key point. No central authority for education exists in Europe; each Member States is sovereign. How to provide governance for a decentralized and autonomous governances system?

To accomplish that, a framework governance for issuing verifiable credentials has been developed. Each Member State will be able to define what we call Trusted Accreditation Bodies, that will authorize and accredit the educational institutions in the accredited education model.

More than one accreditation organization can exist per level of education, so existing governance can be deployed over EBSI.

Diploma UC features in EBSI v2

The set of BS that are a must to enable the use case:

- Register a Schema
- Registration in the trusted accreditation registry (TAR)
- Authorize an educational organization - registration in the Trusted Issuers Registry (TIR)

Set of business scenarios to let natural or legal persons onboard on EBSI:

- Student Onboards on ESSIF with national eID
- Educational institution Onboards on ESSIF

Set of business scenarios for requesting and issuing digital credentials

- Request of an accredited credential
- Request of a non-accredited credential
- Student Requests, an Educational Institution issues and the student accepts and stores a recognition statement (used to be called attestation)

Set of business scenarios to let citizens, students, share the gained credentials with third parties, like an employee or an educational institution

Set of business scenarios related to revocation or suspension

- Two related to the capability of an issuer to revoke or suspend a previously issued digital credential

Set of business scenarios related to mandates, or giving consent:

- A student can give consent to an educational institution on enrollment, so the educational institution will be able to issue learning outcomes to the student as these are achieved
- Or a student can give a mandate to another natural person, for example one of his parents, to interact with an educational service on his behalf
- And, of course, the student, the citizen can revoke a previously given consent or mandate

Finally, maybe this is more related to identity and authentication than to Diploma UC itself, but we think it can be a glue for accessing existing services provided by educational institutions. But it will illustrate how to access to an existing educational service, for example a Learning Management System, using verifiable credentials, for example, requiring and verifying a filed, an attribute, like a university record number (or the European Student Card number) previously issued to the student in the form of a verifiable attestation on enrollment

Biographies



Lluís Alfons Ariño Martín is a computer engineer with more than 25 years of experience in IT specialized in the higher education sector. Linked to the Rovira i Virgili University, in his work he fosters a holistic vision of the business, establishing the objective of adding value to the business, aligning IT in the global strategy of the university.

Having different recognitions throughout his professional career, he likes to highlight the "IT career award" granted by the ICT Sector Committee of the Conference of Rectors of Spanish Universities (CRUE-TIC), for the recognition that represents the fact of that it comes from colleagues from all Spanish universities.

Related to Blockchain, Lluís collaborates with the BlockChain working group of the National Association of Rectors of Spanish Universities (CRUE), linked to the ICT Committee (CRUE-TIC), in the deployment of the BLUE network (Blockchain Spanish Universities) and he is also a member of the Spanish delegation at the European Blockchain Partnership (EBP) in the Diploma Use Case, on behalf of CRUE, of which he is also convenor.