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Making Sense of the Key Data Standards for Verifiable LERs

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Learning and employment records (LERs) such as diplomas, transcripts, badges, micro-credentials, certifications, and work experiences are being published as verifiable digital credentials according to the well-established and supported technology standard, W3C Verifiable Credentials (VCs) (https://www.w3.org/TR/vc-data-model/). This web specification provides the guidelines and models for how to develop software that issues and verifies cryptographically secured digital credentials that are flexible enough to accommodate identity verification, supply chain management, government documents, and also learning and employment records. This paper describes how VCs have increased the efficacy and integrity of digital learning and employment records, reviews the roles and activities involved with VCs, and discusses the status of the education data standards that are adjusting to this new paradigm.

Introduction to Verifiable LERs

VCs became a web standard to make it possible for machines to verify that digitally signed data hasn't been tampered with since it was signed and that the entities who signed the data can be trusted. This has enabled opportunities for interoperability amongst LERs as well as with other verifiable published claims on the web including documents issued by governments and institutions such as proof of citizenship, visas, vaccination records, financial records, and driving licenses. These credentials along with LERs can provide verifiable proof that can be used online to accomplish things like finding jobs and securing loans without human intervention or contacting the issuer of the credentials.

While VCs are flexible enough to be used to provide cryptographic proof for any claims being made on the web, the use cases for the W3C Verifiable Credentials (VC) specification originated with learning and employment scenarios being implemented with the Open Badges specification (http://www.imsglobal.org/activity/openbadges), one of the original digital credentials to be used online to describe learning happening anytime, anywhere. Because of this, the VC specification inherently provides modeling that accommodates learning and employment claims (https://w3c-ccg.github.io/vc-ed-use-cases/)

The initiative to pair education data standards with the VC model to produce LERs started at the W3C Verifiable Credentials for Education Task Force (VC-EDU) which was established by the Digital Credentials Consortium (DCC) (https://digitalcredentials.mit.edu/), a group of higher education institutions with a purpose to design a digital infrastructure for academic credentials using and facilitating open standards. VC-EDU is the leading group providing resources to demonstrate how LERs can be issued as VCs as well as guidance for education data standards.

About Verifiable Credentials

The methodology for the trust model of VCs puts the holders of the credentials at its center. Learners and earners have the opportunity to determine which online identity the credentials should be issued to. Once the credentials are issued they can be stored in digital wallet applications where they can be accessed whenever they are needed and shared privately. The credentials contain structured metadata describing the achievement claims and cryptographic proof for verifiers to

ensure that the credential has not been tampered with since it was issued, hasn't expired, is still valid, and that the participating entities, the issuers and holders of the credentials, are who they say they are. This verification can be done without contacting the issuer to maintain the privacy of the learners and earners while reducing overhead for the issuers who typically would need to be contacted directly by phone or email to ensure that a degree or employment claim is true.

Just as registered or certified mail use sealed envelopes to securely and privately deliver letters to the intended recipients, Verifiable Credentials are secured digital envelopes that contain descriptions of the claims being made. To secure the claims, the envelopes are digitally signed by the issuers of the credentials. The issuers are also listed in trust registries, public lists of the issuer information that are monitored by trusted entities such as governments, accreditation boards, or consortiums like the DCC. Verifiers of the credentials use these registries to ensure that issuer identities are associated with the cryptographic keys used to sign the credentials.

The structured metadata in VCs uses a format called JSON-LD (https://json-ld.org/learn.html), a type of data that makes it possible for there to be links from one document to another. With VC LERs this is helpful because the terms used to describe achievements and how they can be verified reference vocabularies hosted online so that humans and machines can understand what the terms mean in the context of the credentials. There are many of these vocabularies available and by using linked data, the most appropriate vocabularies can be used to structure the data so that VC LERs make sense for all of the entities involved.

It's worth noting that there are ways for VCs to serve data that are in different formats other than linked data. This is less useful and interoperable than JSON-LD because without a contextual vocabulary to reference, the credentials make less sense to the machines that read them. However, not all LERs will be issued as VCs immediately. It will take some time for adoption and it will be necessary for digital credentials issued in the past to be accommodated too.

Some learning and employment data standards currently use the XML format (https://en.wikipedia.org/wiki/XML). XML has been in existence for 27 years and many records may exist in this format. Fortunately, it is possible to reference XML terms in a VC. This provides a bridge allowing for records to still be content rich and digitally signed. It is also possible to insert credentials in a VC using the LER Wrapper specification (https://www.t3networkhub.org/resources/public-specification-for-learning-and-employment-record-ler-wrapper-and-wallet) which provides a method to digitally sign a credential that makes a claim about another credential. This is useful if a digital credential is a PDF, or a fully formed credential in XML or some other format.

Data Standards & Vocabularies

There are various education data standards and vocabularies (https://www.edmatrix.org/matrix) which are intended to provide a common or shared understanding of how to describe competencies and course descriptions. Traditionally these were created to serve institutional system-to-system data transfers. In the past decade or so, new and more flexible digital credential standards and vocabularies have emerged to assert and describe recognition of skills and achievements within formal but also non-formal education, workforce training, military service, and informal experiences. This has resulted in descriptive digital credentials being issued to individuals giving them the power to demonstrate their knowledge, abilities, and experiences for potential evaluation by future employers, institutions, peers and to be useful in systems such as those used for hiring, finances, and online networking.

The two most widely used digital credential standards with complementary data models to describe achievements are Open Badges (https://openbadges.org/) and Comprehensive Learner Record (CLR) (https://www.imsglobal.org/activity/comprehensive-learner-record).

- Open Badges is one of the first digital credentials standards that describes an assertion of an achievement including who asserted the achievement, how it was achieved, by whom, and when.

- CLR describes multiple linked achievements such as course history in a college transcript.

Open Badges describe a single achievement issued to a single recipient by a single issuer. An Open Badge may describe a degree, license to teach or practice medicine, or a micro-credential representing attainment of a skill or completion of a course. Conversely, the CLR is a credential that contains one or more credentials.

For example, a CLR may be digitally signed by a registrar at an institution that contains several Open Badges issued by the registrar or other departments at the institution such as course completion credentials issued by the math and english departments. Each of those course completion credentials could both be issued to a student as individual credentials and then they could be included in a CLR by the registrar to demonstrate completed courses that fulfill a degree requirement. In comparison, an Open Badge could represent a degree but a CLR represents the series of courses completed to fulfill the degree requirements.

Both of these standards had their own models for asserting and verifying issued credentials but the newest versions, Open Badges 3.0 (https://1edtech.github.io/openbadges-specification/ob_v3p0.html) and CLR 2.0 (https://1edtech.github.io/ComprehensiveLearnerRecord/docs/clr_v2p0.html), are modeled according to the W3C Verifiable Credentials standard based on a recommendation proposed by VC-EDU.

These are two of the first LER standards to adopt the same verification methods as VCs and can accommodate many of the use cases for learning and employment records. They have sufficient vocabularies to describe achievements and profiles of issuers, but in some instances, credentials need more information. Vocabularies such as Schema.org (https://schema.org/) and Credential Transparency Description Language (CTDL) (https://credreg.net/ctdl/handbook) include hundreds of additional human and machine readable terms that can be included in Open Badges & CLRs.

Schema.org was founded by Google, Microsoft, Yahoo and Yandex to manage shared vocabularies used on the web. The Credential Transparency Description Language (CTDL) was created specifically to describe learner and worker records. Both Open Badges and CLR have some commonalities with these schemas already. Some of their terms are the same as schema.org and both describe “achievement type” using the same terms used in the CTDL.

Another useful element to add to digital credentials are descriptions of skills and competencies. As with shared vocabularies, shared descriptions of skills and competencies increases semantic interoperability. As with CTDL, CTDL-ASN (https://credreg.net/ctdl/handbook#ctdlasnschema) is intended to be used in learner and employment records to describe knowledge, skill, and ability descriptions. It is built upon an existing description language called Achievement Standards Network Description Language (ASN-DL) that was developed under funding from the U.S. National Science Foundation (NSF) between 1999 and 2013. Rich Skill Descriptors (RSDs) (https://www.openskillsnetwork.org/rsd) describes a structure that can be used with CTDL & CTDL-ASN to establish unique URLs and metadata that describe alignment with skills and job categories.

As with CTDL-ASN, The Competencies and Academic Standards Exchange (CASE) (https://www.imsglobal.org/activity/case) is another standard that provides a way to add information about competencies

to credentials. CASE entries can contain information about rubrics, competency definitions, and identifiers about learning outcomes.

Progressing towards VCs

W3C Verifiable Credentials is a relatively new standard and it's only been in the last few years that there's been movement towards using if for LERs. As mentioned above, learning and education standards have been in existence for over twenty-five years. Many of these have been formatted as XML and are making movements towards adopting the VC model.

A new version of the Europass Learning Model (ELM) (https://github.com/european-commission-empl/European-Learning-Model/tree/3.1) was launched in May 2023. This version replaces the old XML model with a new model using JSON-LD. As with Open Badges, the ELM Verifiable Credentials can describe qualifications, learning activities, achievements, accreditations, etc. It can also be used to describe student identity and memberships. The ELM is part of the European Digital Credential for Learning (EDC) infrastructure which includes an online credential builder, issuer, and displayer.

The Postsecondary Electronic Standards Council (PESC) is an open education data standards organization known for multiple standards including the high school and college transcripts. PESC launched a JSON-LD Task Force that released PESC Compliant JSON v1.0 (https://www.pesc.org/pesc-approved-standards-1.html) in 2019 which describes how to interpret their XML schema as JSON.

The LER-RS Resume Standard (https://www.hropenstandards.org/ler-rs) will be released in 2023 by the HR Open Standards Consortium. It enables people to communicate a rich set of trusted, structured information about their education and work experience. This digital resume will use the verifiable credentials model to make declarations of skills and experiences machine readable and shareable from digital wallet applications.

Harmonizing Vocabularies

W3C Verifiable Credentials provides a model that can increase interoperability amongst credentials by referencing vocabularies and standardizing how claims may be proven. This makes it more possible to understand what each credential is intending to communicate. When comparing credential to credential, it will be useful to know how the vocabularies align with each other.

One approach being developed to seek this harmonization is the T3 Open Competencies Network's Data Ecosystem Mapping Tool (https://wiki.t3networkhub.org/wiki/OCN:_DESM_Tool). The OCN-DESM embraces the existence of many education data standards and provides a translation amongst the participating standards. This tool is in the piloting stage but the preceding data standards mapping tool (https://credreg.net/page/t3mapping) demonstrates the possibilities.

Where Do We Go from Here?

While work on verifiable LERs is ongoing, these advancements have made it possible to digitize interoperable learning and employment records now. The W3C Verifiable Credentials specification provided the scaffolding for standards like Open Badges 3.0 and CLR 2.0 to be more secure and useful across many contexts. The next step is demonstrating how this can be done. Over the next year, VC-EDU plans to publish credential "recipes" for the use cases they've documented to provide developers with actual examples to emulate. Over time, it's anticipated that issuance of verifiable LERs will increase and be used as key reflections of experiences that will unlock and reveal opportunities for many.