

Blockchain 4 Education

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Abstract¹. Certificates play an important role in education and companies, where individual learning records become essential for people's professional careers. It is therefore important that these records are stored in long-term available and tamper-proof ledgers. Until today, training facilities, educational institution or certification authorities issue paper-based certificates and certification processes are not digitized. Blockchain technology could support this transformation from paper certificates to digital certificates and it could help to generate learning histories. In this demonstration, we present the Blockchain for Education platform as a practical solution for issuing, monitoring, validating and sharing of certificates. The Blockchain for Education platform is based on the Ethereum blockchain and it uses smart contracts to support the certification process.

Introduction

Certificates confirm the achievement of certain learning outcomes. Until today, certificates are usually issued on paper, which has several advantages. For example, recipients can easily store them and present them to any person and for any purpose. In addition, it is difficult to forge paper certificates if there are built-in security features. However, third parties need extra effort to verify paper certificates. Verification is usually achieved by asking the issuing certification authority, i.e. certification authorities have to maintain a long-term archive [1].

Blockchain is a foundational technology that documents transactions in a decentralized, secure, transparent and immutable way and has a major impact on

¹ This paper is an excerpt of [17].

design and implementation of digital business processes in many application areas such as Internet of Things, smart grid, supply chain, finance or notarization [2, 3, 4]. Process automation is achieved by so-called smart contracts that are stored in the blockchain.

Blockchain technology could support the digital transformation of certification processes. The Blockchain for Education platform represents paper certificates as digital certificates and their fingerprints (unique hashes) are written on the blockchain. In addition, the identities of certification authorities and certifiers are also stored into the blockchain. Finally, smart contracts support management of certification authorities and certifiers as well as monitoring or revocation of certificates.

Related work

Blockcerts, developed by MIT media lab together with Learning Machine is an open-source ecosystem for creating, sharing, and verifying educational certificates. The educational certificates are compliant with Open Badges standard and are registered on the Bitcoin blockchain [5, 6]. Based on blockcerts, a pilot for academic and professional certifications is currently under development in Malta [7] and the Federation of State Medical Boards in the US is currently launching a pilot for the issuing of official documents [8].

TrueRec, developed by the company SAP, is an Ethereum-based blockchain system that stores professional and academic credentials [9]. TNO started recently the blockchain project self-sovereign identity framework. This framework is designed to help supply official information in digital form and only share a minimum amount of personal data [10, 11]. Sovrin is another infrastructure that aims to support digital identities on a global scale [12]. The Apostille notarization service supports use cases such as digital media licenses or car ownership [13].

System Description

In order to build the Blockchain for Education platform a minimal viable product was defined based on requirements elicited in several workshops with application partners, educational institutions and two certification authorities. The main features for certification authorities and certifiers are import of data and examination results from legacy systems, creation of digital certificates, signing and issuing them into the blockchain, monitoring and revocation of certificates as well as confirming validity and authenticity of certificates. Storing and archiving of digital certificates and the creation of application portfolios are the necessary features for learners. Employers need features to read and validate digital certificates.

After having elicited the requirements, the Blockchain for Education platform was conceptualized and a prototype system based on the Ethereum blockchain [14] was implemented. The InterPlanetary File System [15] is used to store profiles of certification authorities and the BSCW document management system [16] stores digital certificates that are represented as extended Open Badges. BSCW supports certification authorities in management of certificates and learners in the organization and sharing of application portfolios. Employers are supported by a verification service for digital certificates. Two smart contracts have been developed in Solidity. An overview of the conceptual architecture of the Blockchain for Education platform is shown in Fig. 1.

In a bootstrapping process (step 1), the smart contracts IdentityMgmt and CertMgmt are written to the Ethereum blockchain by the accreditation authority. After that, the accreditation authority could register profiles of certification authorities (2a) and at the same time their respective identities on the blockchain (2b). The certification authority could register identities of certifiers on the blockchain (3).

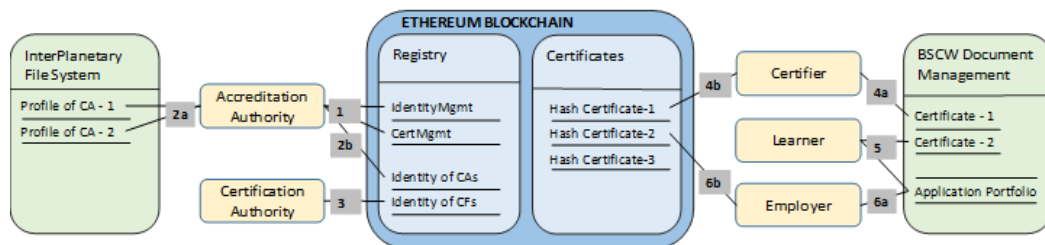


Fig. 1. Conceptual architecture of the Blockchain for Education platform.

Certifiers collect all necessary information, sign and issue the certificate. It is stored on the BSCW document management system and its fingerprint is written to the Ethereum blockchain (4a, 4b). Learners receive their certificates and can create application portfolios (5) that could be shared with potential employers (6a). Employers use a verification service to check the authenticity of certificates.

Summary

The demo demonstrates the combination of the cooperative process of issuing a certificate with a blockchain infrastructure. Furthermore it also exemplifies the interplay of the groupware BSCW with a blockchain. We hope that this demo will stipulate further discussions around blockchain and CSCW [18]. Further information on the system and its future development is available here [19].

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