

[06] However, many problems exist with providing and utilizing identities. The traditional nature of some existing identities and authorization procedures presents a danger of fraud as developing technologies prove increasingly effective at counterfeiting such identities. For example, traditional identity cards, documents, etc., even if they contain anti-counterfeiting measures such as incorporated marks, holograms, etc., are increasingly subject to successful reproduction by modern techniques. Even digital identities remain vulnerable to correspondingly digital techniques.

[07] The large variety of identities, identity providers, and third party systems also has resulted in a highly differentiated identity environment. An individual typically needs to interact with a multitude of identity providers to create a corresponding number of identities, which the individual must then maintain and provide in a varying fashion to a multitude of different third parties. Likewise, many third parties find it necessary to accept, and thus provide a corresponding verification mechanism, for a variety of different identities. Such a fractured identity environment creates inefficiencies in producing and utilizing identities for both individuals and third parties.

[08] Thus, a need exists for devices, systems and methods to create, verify, and maintain identities with increased security and efficiency.

SUMMARY OF THE INVENTION

[08a] According to a first aspect of the present invention, there is provided a method of verifying an identity, the method comprising: generating, by an identity system, an identity token incorporating an identifier representing identity data of an identity generated for an individual by an identity provider, the incorporated identifier being stored in a data structure associated with program instructions of a smart contract of a distributed ledger system, the data structure and the program instructions of the smart contract being stored in a distributed ledger of the distributed ledger system; providing, by the identity system at an interface of the identity system to a user system of the individual, the generated identity token to the user system; receiving, by the identity system at an interface of the identity system to a restricted access system, data extracted from an identity token received by the restricted access system from the user system; determining, by invoking by the identity system execution of the program instructions of the smart contract by a processor of the distributed ledger system, wherein the program instructions of the smart contract comprise an identity verification function, whether at

least a portion of the extracted data matches the identifier stored in the data structure of the smart contract in the distributed ledger of the distributed ledger system; and outputting, by the identity system at the interface to the restricted access system, an indication of a validity of the identity generated by the identify provider based on the determination.

[08b] According to a second aspect of the present invention, there is provided at least one non-transitory, machine-readable storage medium having program instructions, which when executed by at least one processor causes a method of providing identity services to be performed, the method comprising: generating, by an identity system, an identity token incorporating an identifier representing identity data of an identity generated for an individual by an identity provider, the incorporated identifier being stored in a data structure associated with program instructions of a smart contract of a distributed ledger system, the data structure and the program instructions of the smart contract being stored in a distributed ledger of the distributed ledger system; providing, by the identity system at an interface of the identity system to a user system of the individual, the generated identity token to the user system; receiving, by the identity system at an interface of the identity system to a restricted access system, data extracted from an identity token received by the restricted access system from the user system; determining, by invoking by the identity system execution of the program instructions of the smart contract by a processor of the distributed ledger system, wherein the program instructions of the smart contract comprise an identity verification function, whether at least a portion of the extracted data matches the identifier stored in the data structure of the smart contract in the distributed ledger of the distributed ledger system; and outputting, by the identity system at the interface to the restricted access system, an indication of a validity of the identity generated by the identify provider based on the determination.

[08c] According to a third aspect of the present invention, there is provided a system, comprising: at least one processor; at least one non-transitory, machine-readable storage medium having program instructions, which when executed by the at least one processor cause a method of providing identity services to be performed, the method comprising: generating, by an identity system, an identity token incorporating an identifier representing identity data of an identity generated for an individual by an identity provider, the incorporated identifier being stored in a data structure associated with program instructions of a smart contract of a distributed ledger system, the data structure and the program instructions of the smart contract being stored in a distributed ledger of the distributed ledger system; providing, by the identity system at an

interface of the identity system to a user system of the individual, the generated identity token to the user system; receiving, by the identity system at an interface of the identity system to a restricted access system, data extracted from an identity token received by the restricted access system from the user system; determining, by invoking by the identity system execution of the program instructions of the smart contract by a processor of the distributed ledger system, wherein the program instructions of the smart contract comprise an identity verification function, whether at least a portion of the extracted data matches the identifier stored in the data structure of the smart contract in the distributed ledger of the distributed ledger system; and outputting, by the identity system at the interface to the restricted access system, an indication of a validity of the identity generated by the identify provider based on the determination.

BRIEF DESCRIPTION OF THE DRAWINGS

- [09] So that the features of the present invention can be understood, a number of drawings are described below. However, the appended drawings illustrate only particular embodiments of the invention and are therefore not to be considered limiting of its scope, for the invention may encompass other equally effective embodiments.
- [10] FIG. 1 is a schematic diagram depicting an embodiment of a system to provide identity services.
- [11] FIG. 2 is a schematic diagram depicting an embodiment of an integrated identity system.
- [12] FIG. 3 is a schematic diagram depicting an embodiment of a distributed identity element repository.
- [13] FIG. 4 is a schematic diagram depicting an embodiment of a distributed smart contract system node.