Establishment of a Minimum Viable Self-Sovereign Identity Network

Kilian Käslin, 27.01.2020, Kick-Off Master's Thesis

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- Preliminary Architecture
- Sequence Diagram: Register & Login

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Timeline

Motivation: Classic Identity Management & Self-Sovereign Identity

Centralized/Federal/User-Centric Identity

- Dependence on centralized identity providers
  - Privacy concerns
  - No absolute control over identity
- Hierarchical Trust

Self-Sovereign Identity

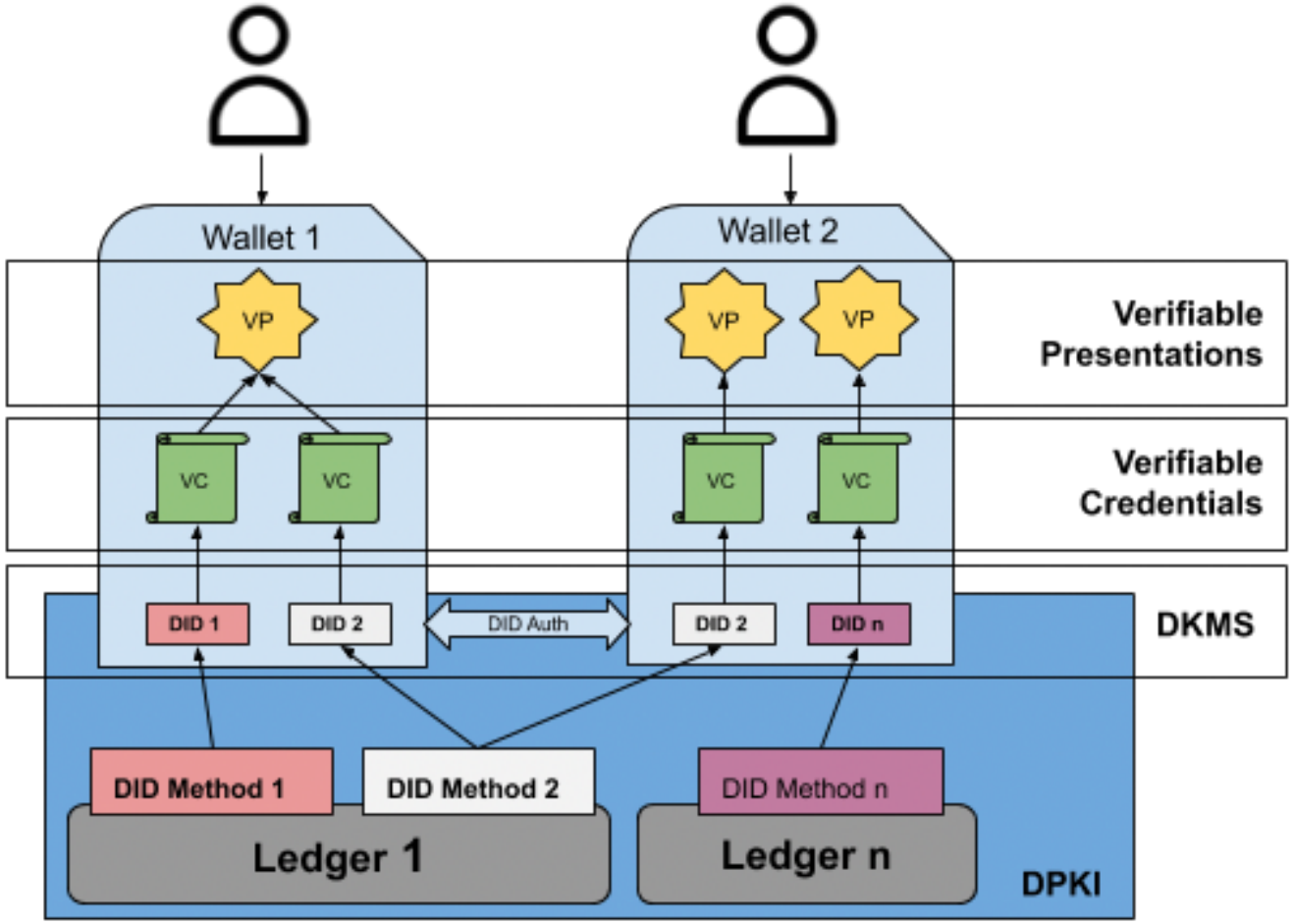
- Identity stored on decentralized database
  - More control over identity
- Attestation of claims
  - Improved control over shared data
- Decentralized Trust

Almasi P. (2019). ‘‘The Identity Revolution — Self Sovereign Powered by Blockchain‘‘.

Introduction to Self-Sovereign Identity

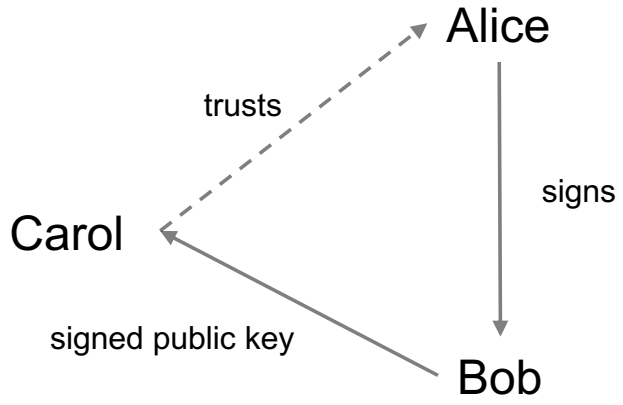
Components of SSI:

- **Web of Trust** between **actors**
- **Wallets** manage VCs, VPs, DIDs
- **Verifiable Presentations (VP)** to share data in a privacy-preserving manner
- **Verifiable Credentials (VC)** to attest personal information
- **Decentralized Key Management System (DKMS)** to manage keys and communication
- **DID Methods** to create and manage **Decentralized Identifiers (DIDs)** on a ledger to establish a **Decentralized Public Key Infrastructure** (**DPKI**)



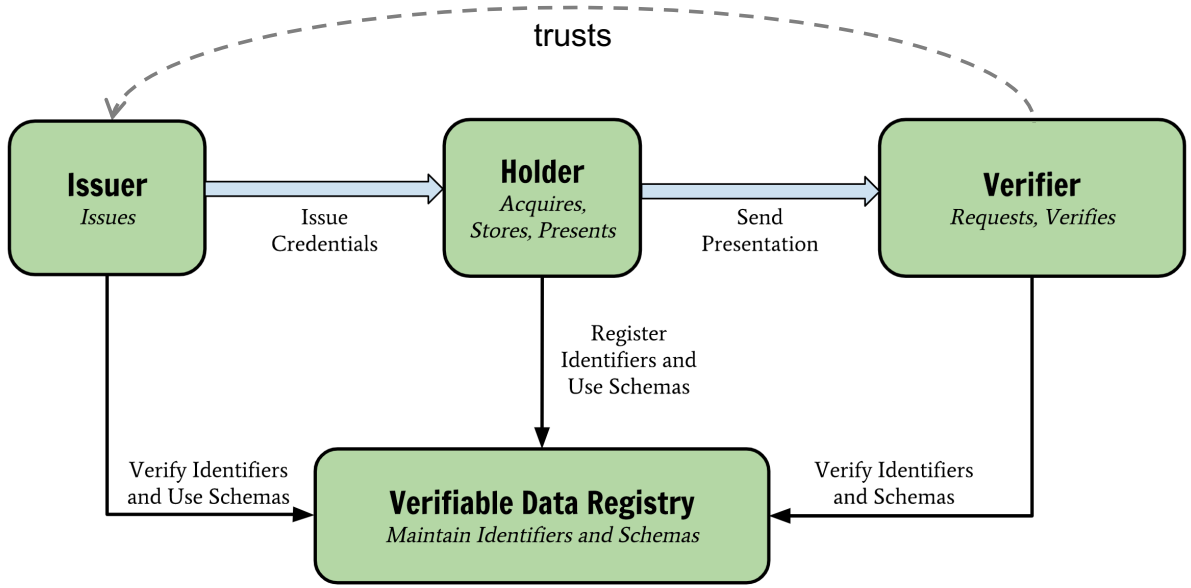
Schäfer, M. 2019. “Analysis and Evaluation of Blockchain-Based Self-Sovereign Identity Systems“.

Trust Models: PGP & Self-Sovereign Identity



PGP

- Individuals sign each others' public keys
- Carol trust Alice
- Alice signed Bob's public key
- Carol trusts Bob based on Alice's signature
- Mostly hierarchical Public Key Infrastructure



Self-Sovereign Identity

- Individuals can proof control over their public key stored on a decentralized database
- Verifier trust Issuer
- Issuer issues a Verifiable Credential (VC) with claims about Holder and a signature
- Holder sends Verifiable Presentation (VP) which Verifier can check
- Distributed Public Key Infrastructure

Abdul-Rahman, A. 1997. "The PGP Trust Model," | Sporny, M., Longley, D., and Chadwick, D. 2019. *Verifiable Credentials Data Model 1.0*.

Problem Statement

Establishment of a Minimum Viable Self-Sovereign Identity Network

- Authentication
- Access Control
- Issuance, Sharing, Proof of Claims

Research Questions

Requirements Engineering

RQ1: **Which requirements must be fulfilled by a minimum viable Self-Sovereign Identity network?**

- Which functional requirements must be fulfilled?
- How can the non-functional requirements be defined?
- Which non-function requirements must be fulfilled?
- Which limitations are induced by relying on Self-Sovereign Identity compared to other possible authentication and access control methods?

Design

RQ2: **What are the main processes that must be implemented to fulfill the requirements for a minimum viable Self-Sovereign Identity network?**

- To which extend are the processes defined by prior works?
- What are the characteristics of the processes?
- How can the processes be implemented?

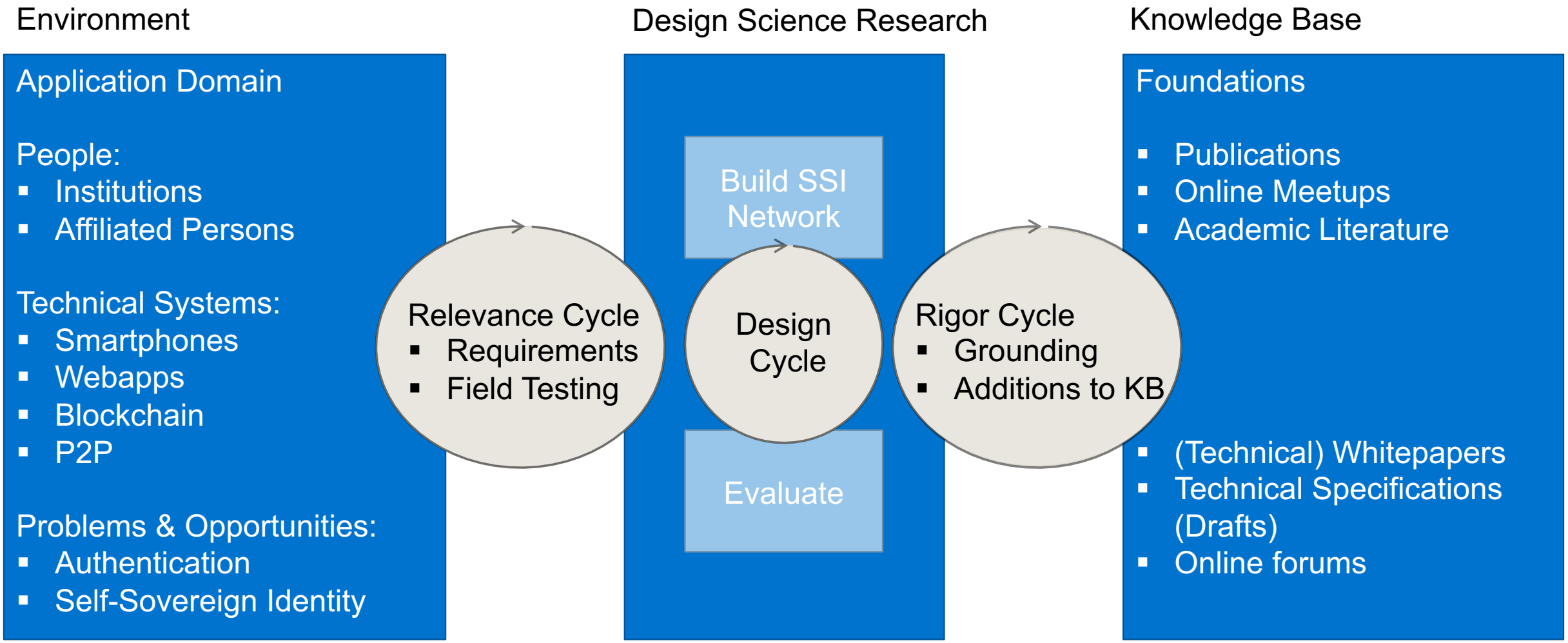
Evaluation

RQ3: **To what extend does the implemented solution fulfil the requirements for a minimum viable Self-Sovereign Identity network?**

- Which limitations does the implementation have?
- What are the differences compared to other authentication methods?

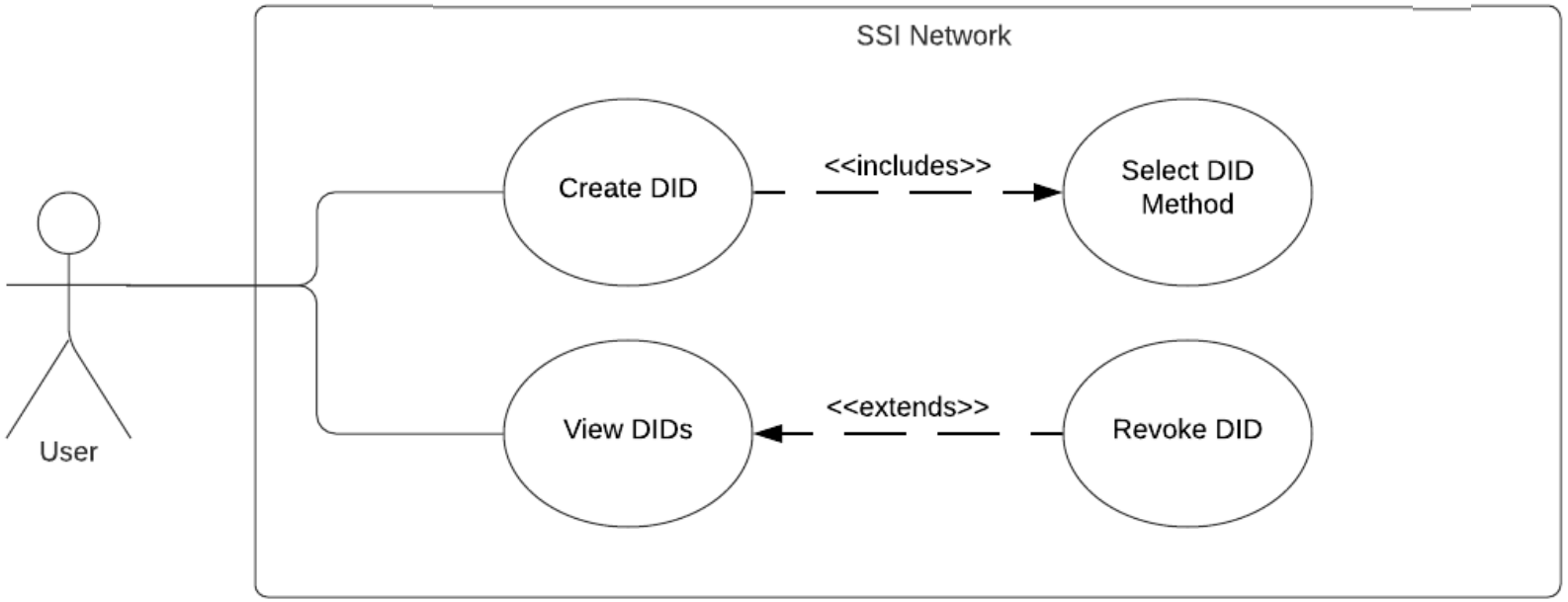
Methodology

Design Science following Alan A. Hevner



Hevner, A. R. 2007. "A Three Cycle View of Design Science Research," *Scandinavian Journal of Information Systems* (Vol. 19).

Functional Requirements – Manage DIDs

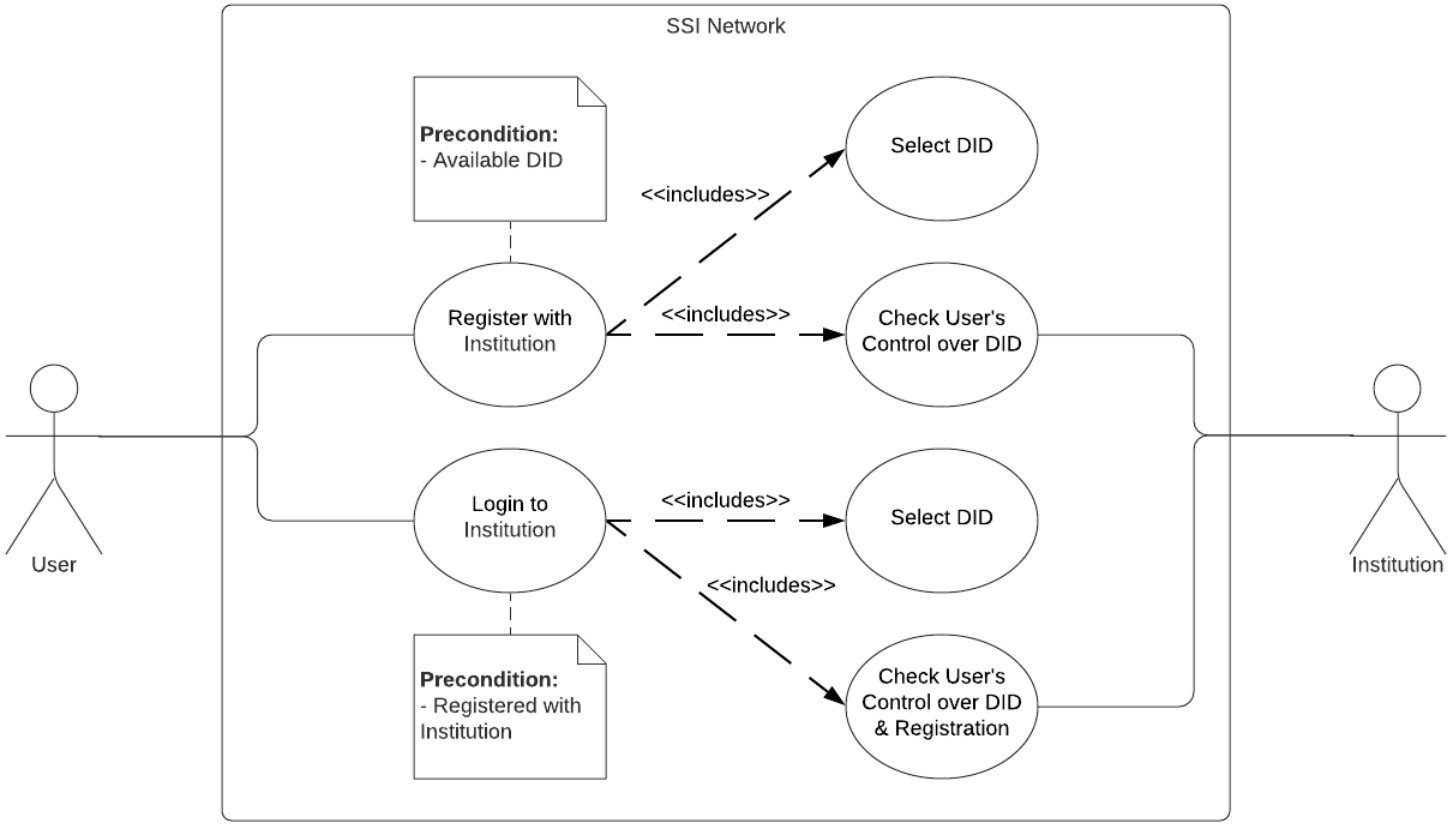


User Story

As a user I can register a DID, so that I can use it to authenticate myself.

As a user I can view my DIDs, so that I can select a DID to be revoked.

Functional Requirements – Register / Login

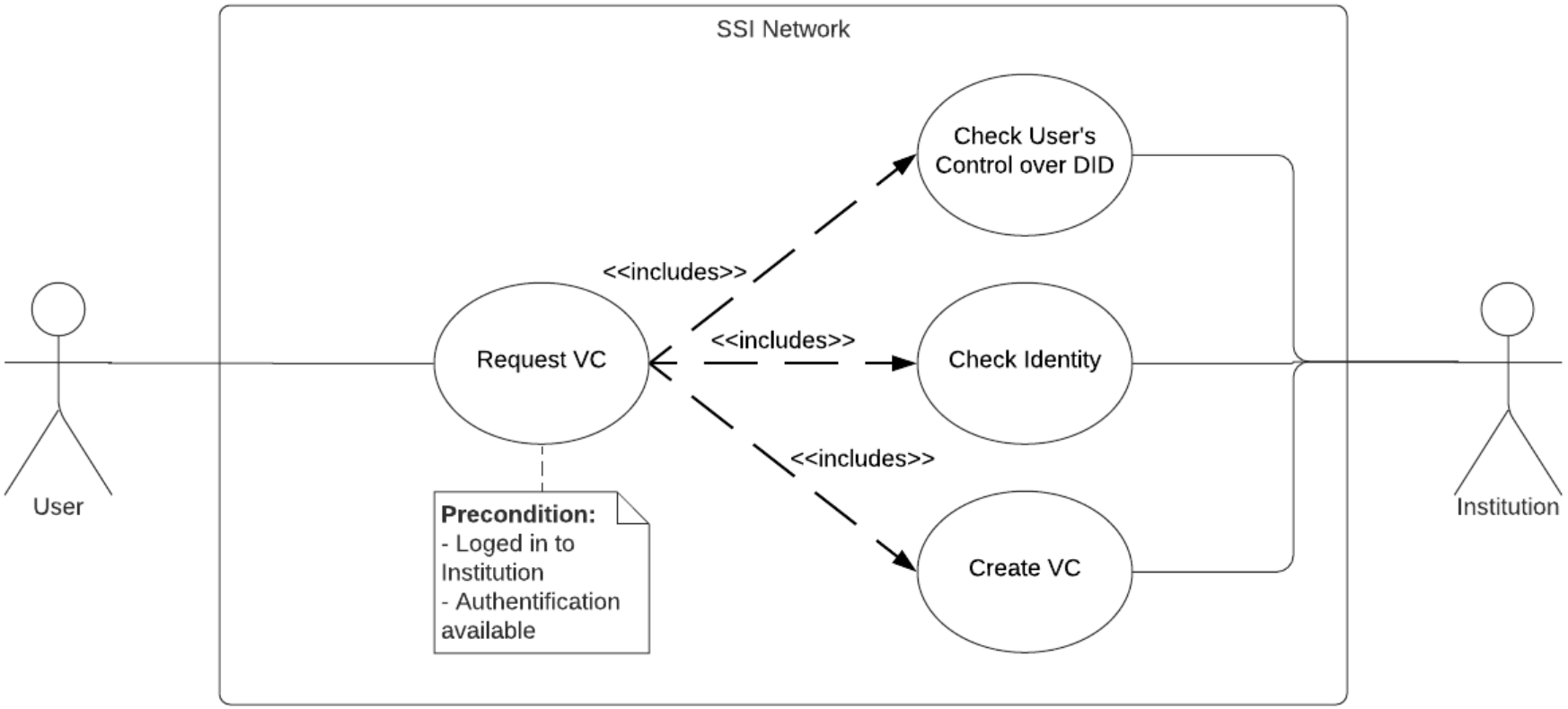


User Story

As a user I can register to Blockchain Bayern, so that I can login to Blockchain Bayern.

As a user I can login to Blockchain Bayern, so that I can use the user portal.

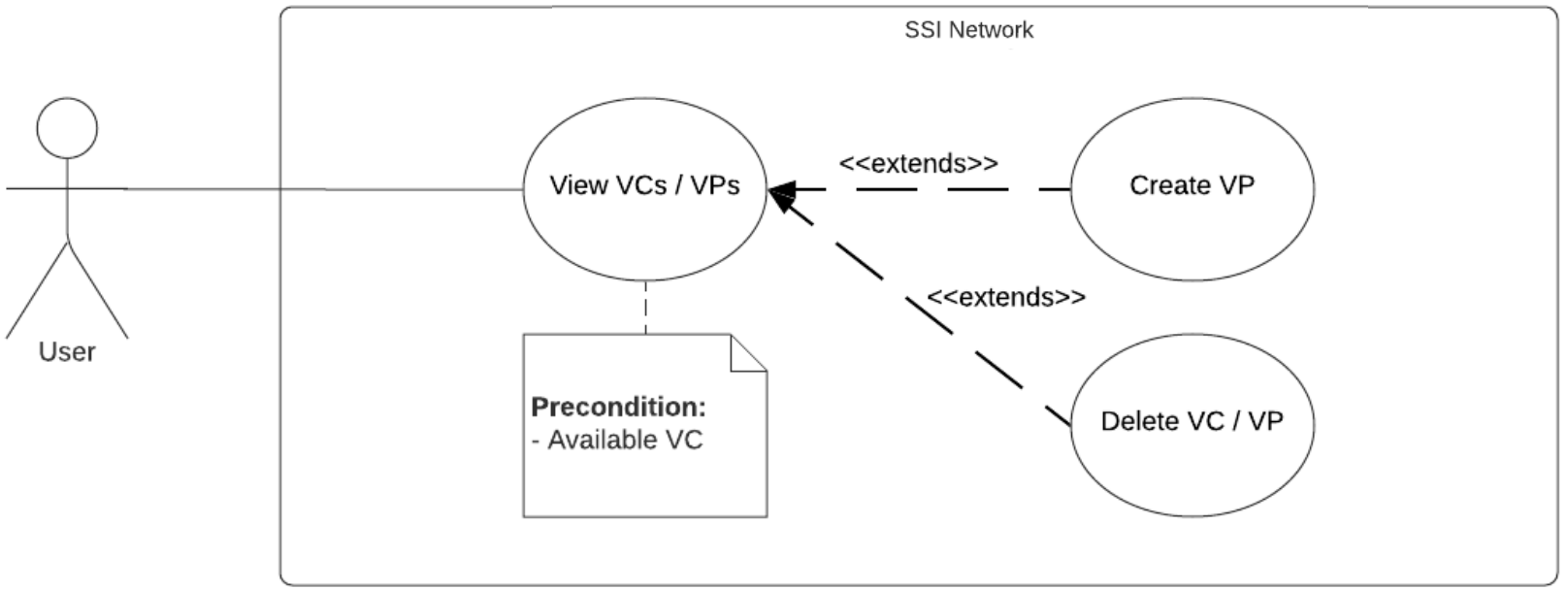
Functional Requirements – Request VC



User Story

As a user I can request a VC, so that I can use it to create VPs to pass on to third parties.

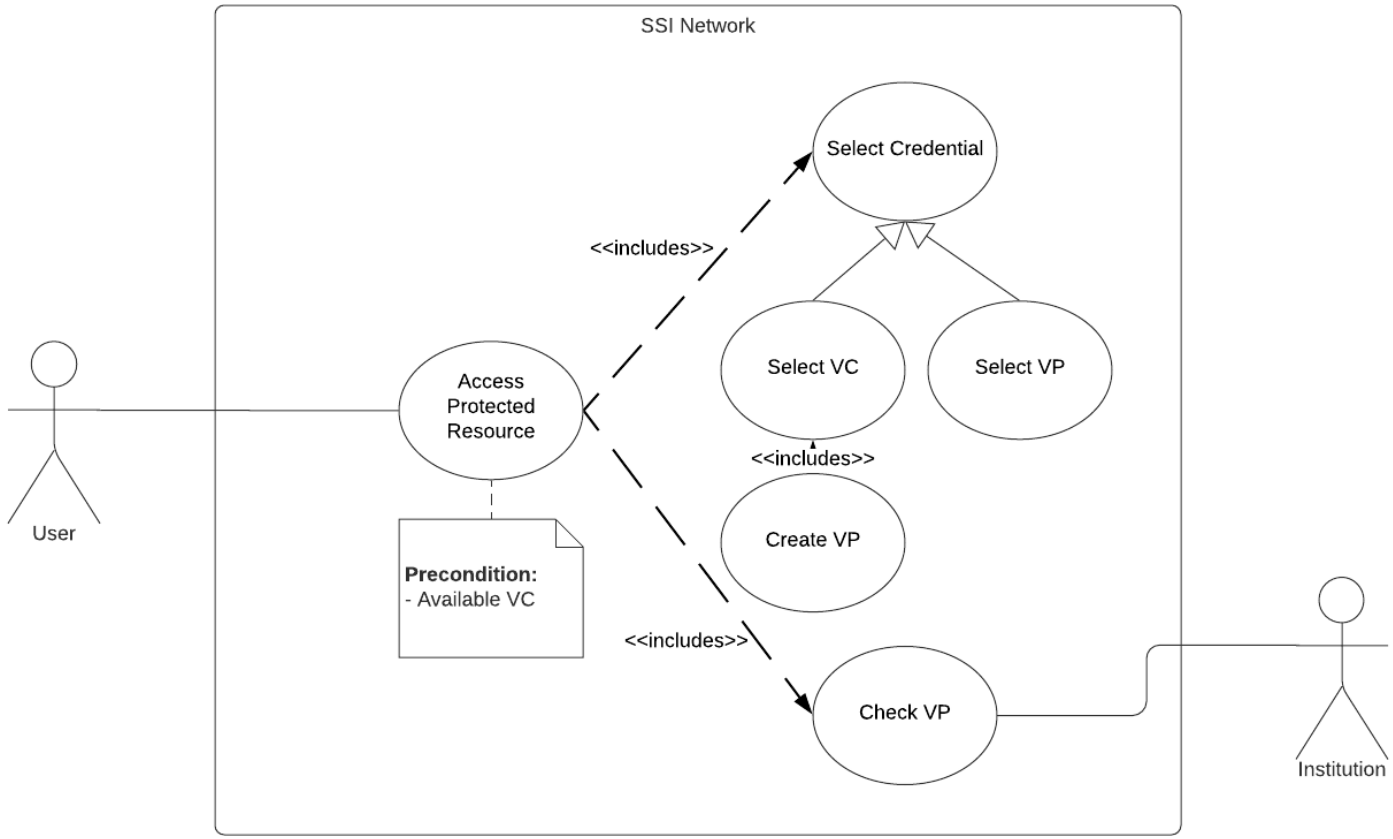
Functional Requirements – Manage VCs & VPs



User Story

As a user I can view my VCs and VPs, so that I can create new VPs to pas on to third parties and delete existing VCs and VPs.

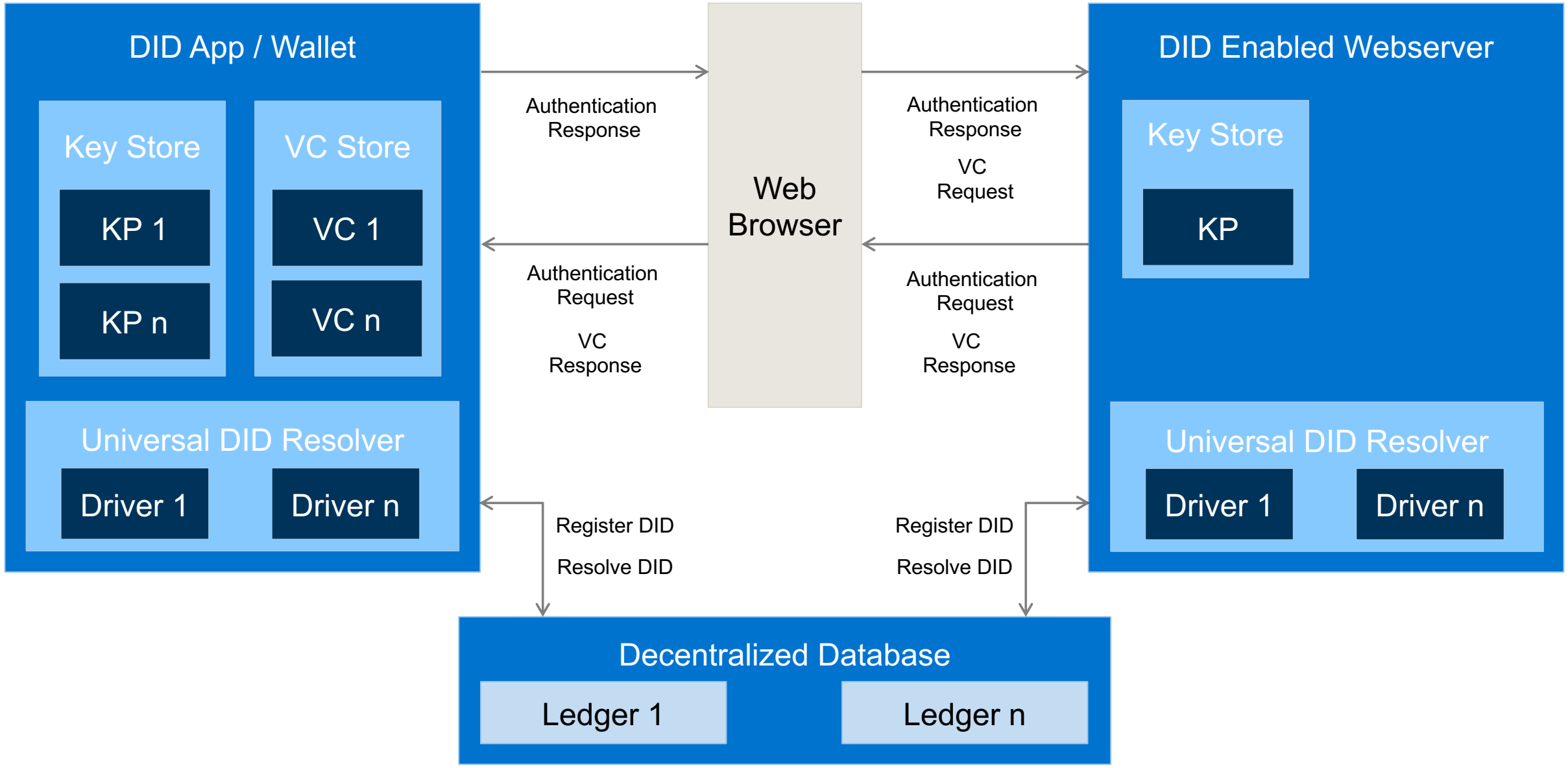
Functional Requirements – Use VCs & VPs



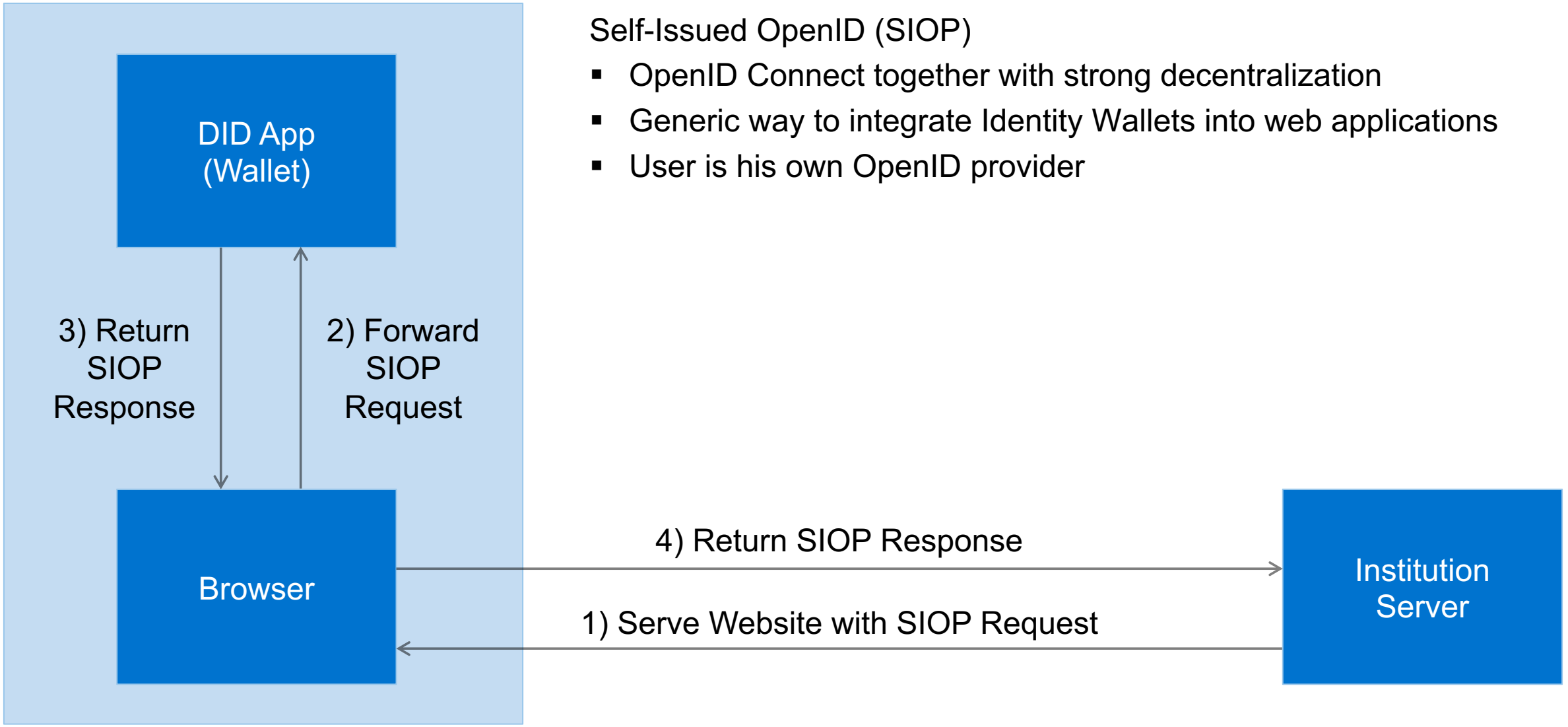
User Story

As a user I can access protected resources, so that I can view them.

Preliminary Architecture



Sequence Diagram – Register & Login



Self-Issued OpenID (SIOP)

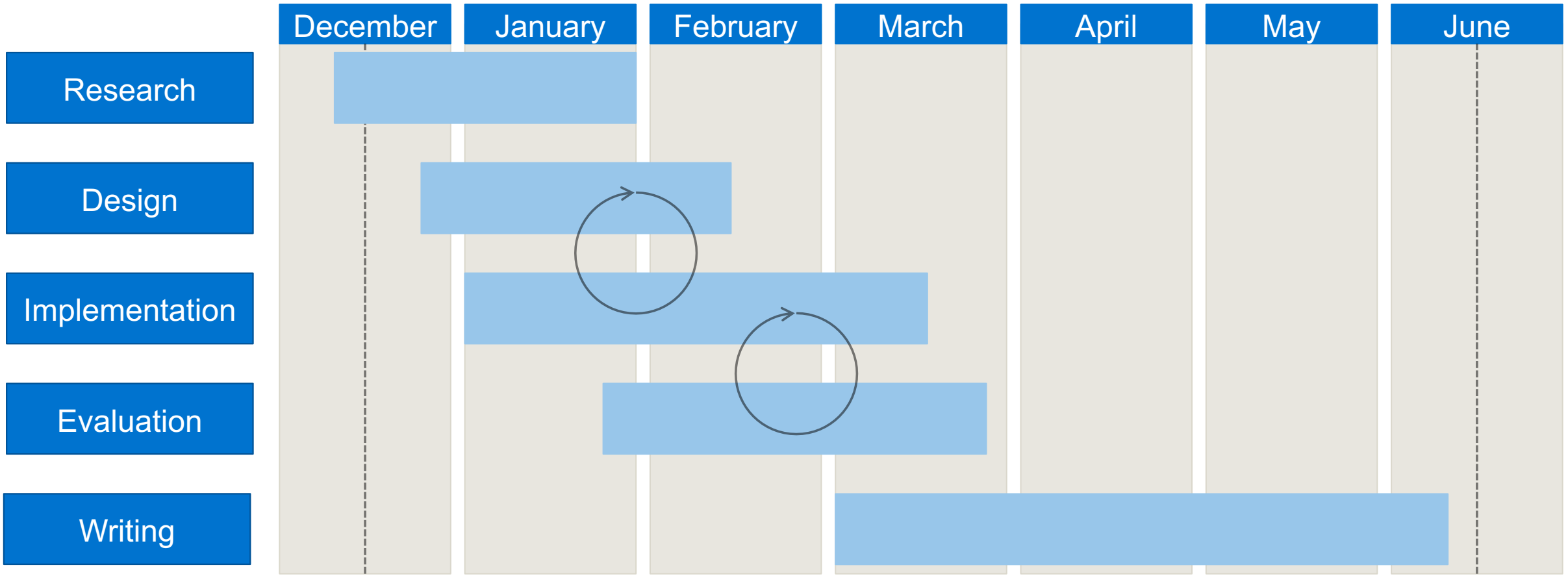
- OpenID Connect together with strong decentralization
- Generic way to integrate Identity Wallets into web applications
- User is his own OpenID provider

Terbu, O., Basart, I., Hartog, K. Den, Lundkvist, C., Stark, D., Zagidulin, D., Strockis, D., and Steele, O. 2019. “Self-Issued OpenID Connect Provider DID Profile.”

Further Expected Results

- **Non-functional Requirements**
- **Process Analysis**: Verifiable Credentials / Verifiable Presentations
- **Implementation** of a minimum viable self sovereign identity network
- **Evaluation** of the implementation against the functional and non-functional requirements
- **Comparison** of the implementation with other authentication methods

Timeline



Registration Date
15. December

Submission Date
15. June

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