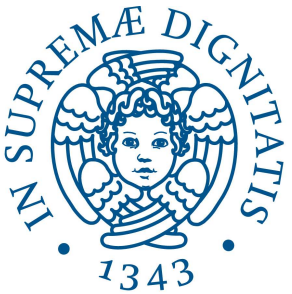


UNIVERSITÀ DI PISA

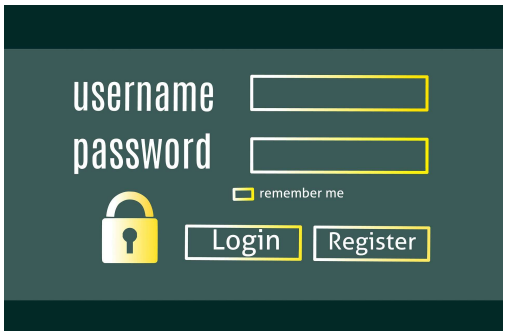
Trust Approaches in Self-Sovereign Identity

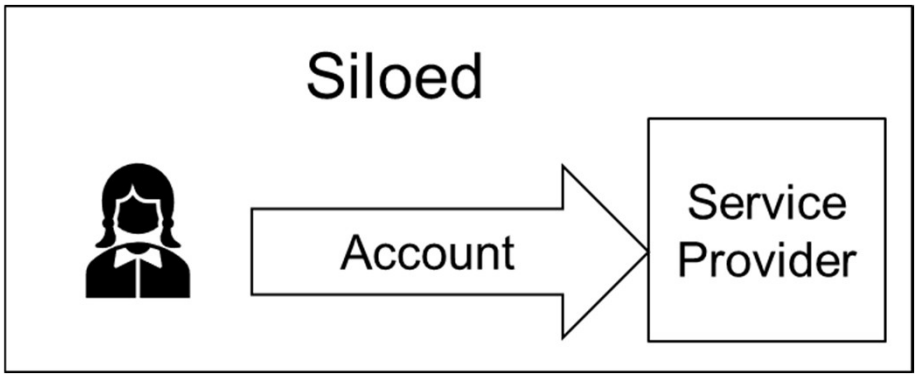
Speaker:
Calogero Turco

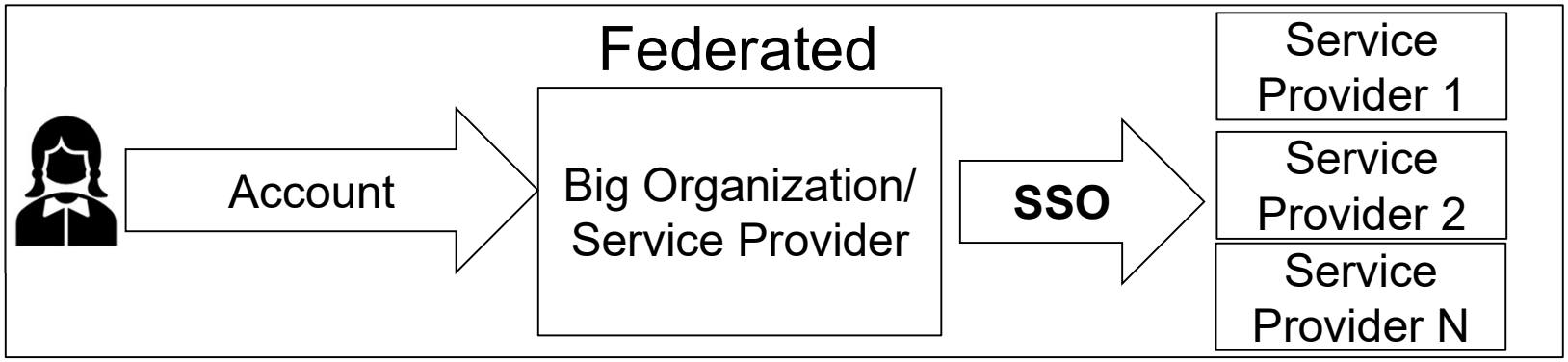
Mauriana Pesaresi's Seminar Series

Traditional Digital Identity

Account Based
- Siloed Identity
- Federated Digital Identity
  - Single Sign-On (**SSO**)
    - Sign in as Google/Facebook



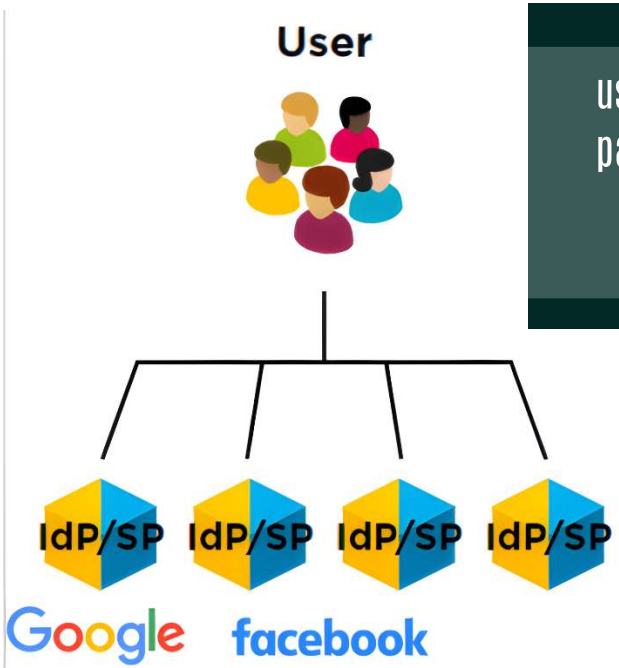




Self Sovereign Identity(SSI)

Traditional Digital Identity

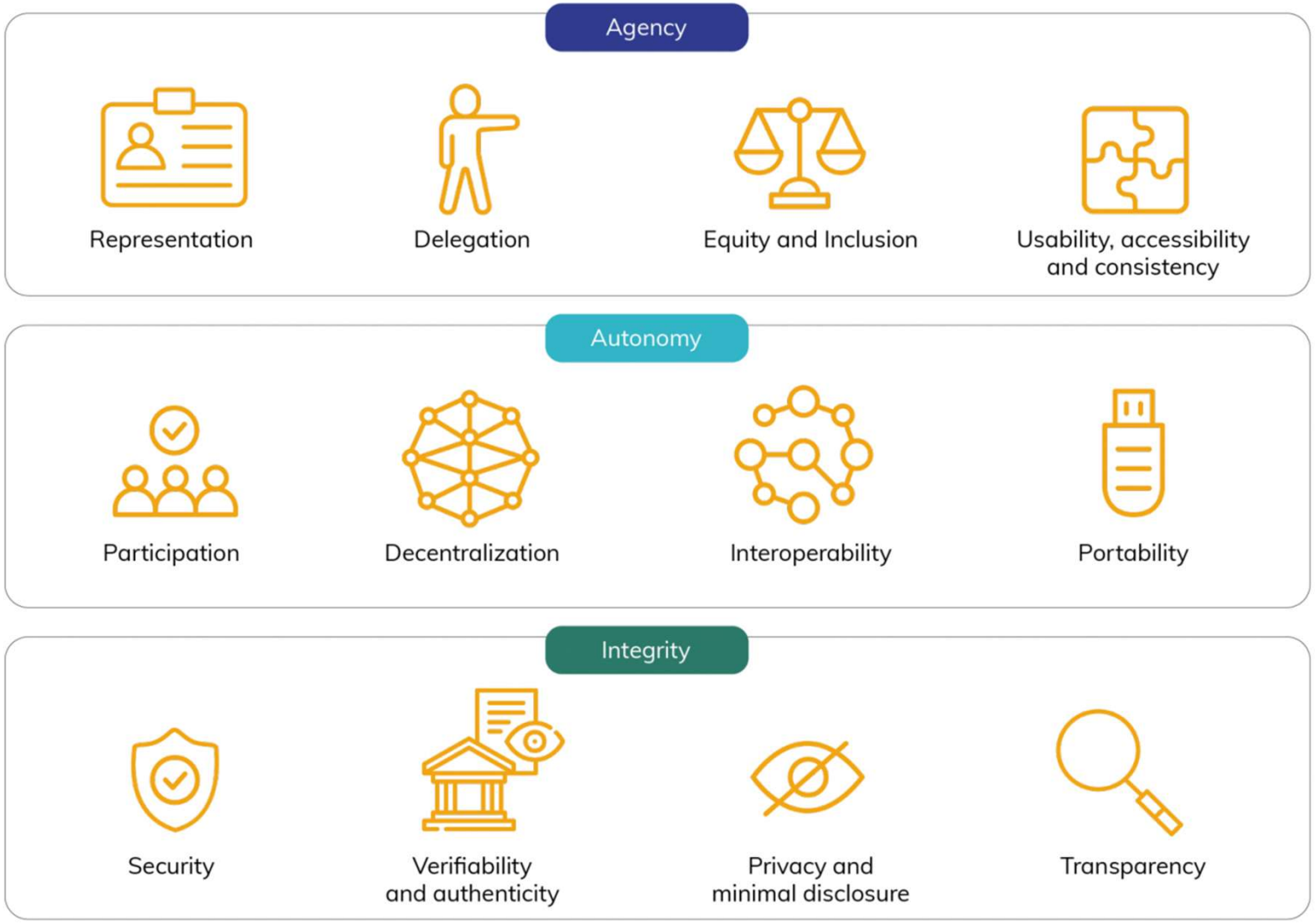
- Absence of control
- Security
- Censorship
- Personally Identifiable Information (PII)
- Designed for humans



Self Sovereign Identity

- From traditional to decentralized identity
- Portability and Sovereignity
- Verifiable Credentials

12 principles of SSI



Verifiable Credentials

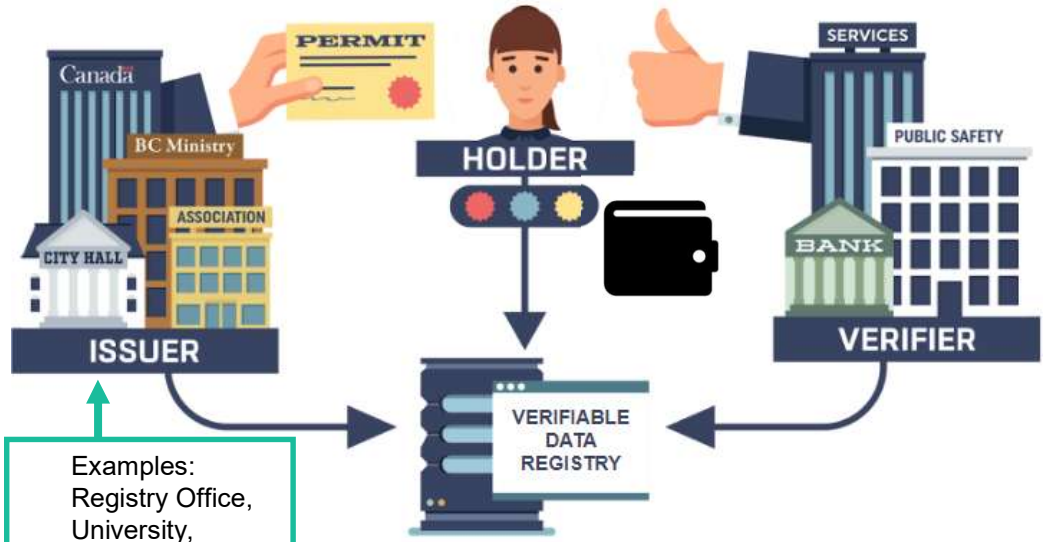
Privacy-Preserving Technology for Credentials

•Used for issuing, storing, and presenting:

- Education degrees
- Government-issued ID cards
- Shipping container manifests
- Certified product information
- Other machine-readable credentials

By Peter Stokyo, peter.stoyko@elanica.com, Licensed under CC By 4.0
https://www.lfdecentralizedtrust.org/blog/2021/04/21/why-distributed-ledger-technology-dlt-for-identity

SSI specifications



Examples: Registry Office, University, School, Ministry, Bank

Verifiable Credentials Data Model by W3C:

- Wallet
- Verifiable Credential (**VC**)
- Verifiable Presentation (**VP**)

From w3.org DID specification

Decentralized Identifiers:

- URI
- Human-readable
- Distributed Ledgers
  - (Blockchains :-))

SSI implementations

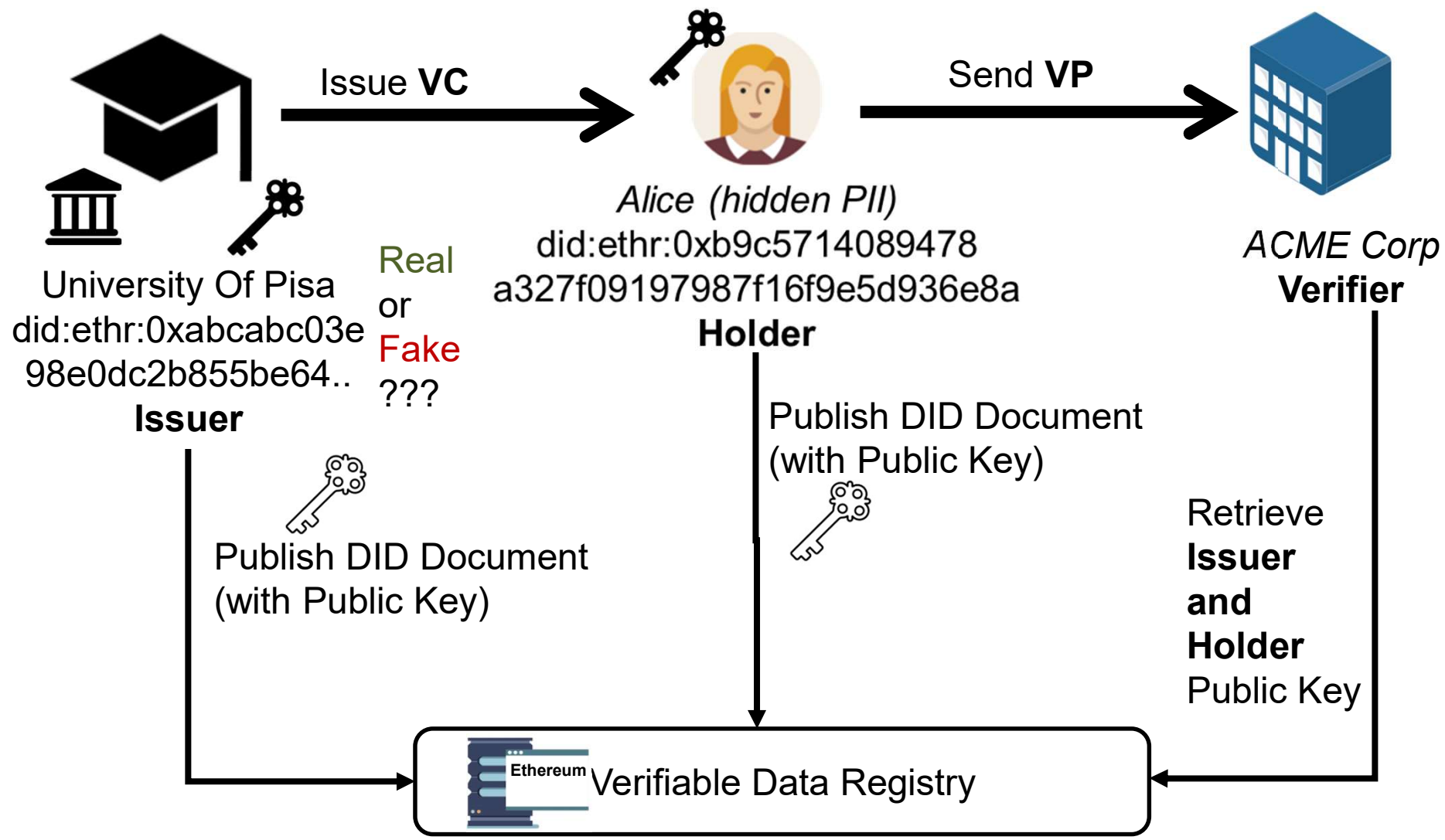
Two major implementations for Verifiable Credential Data Model workflow:

- Veramo
- Hyperledger Indy/Aries

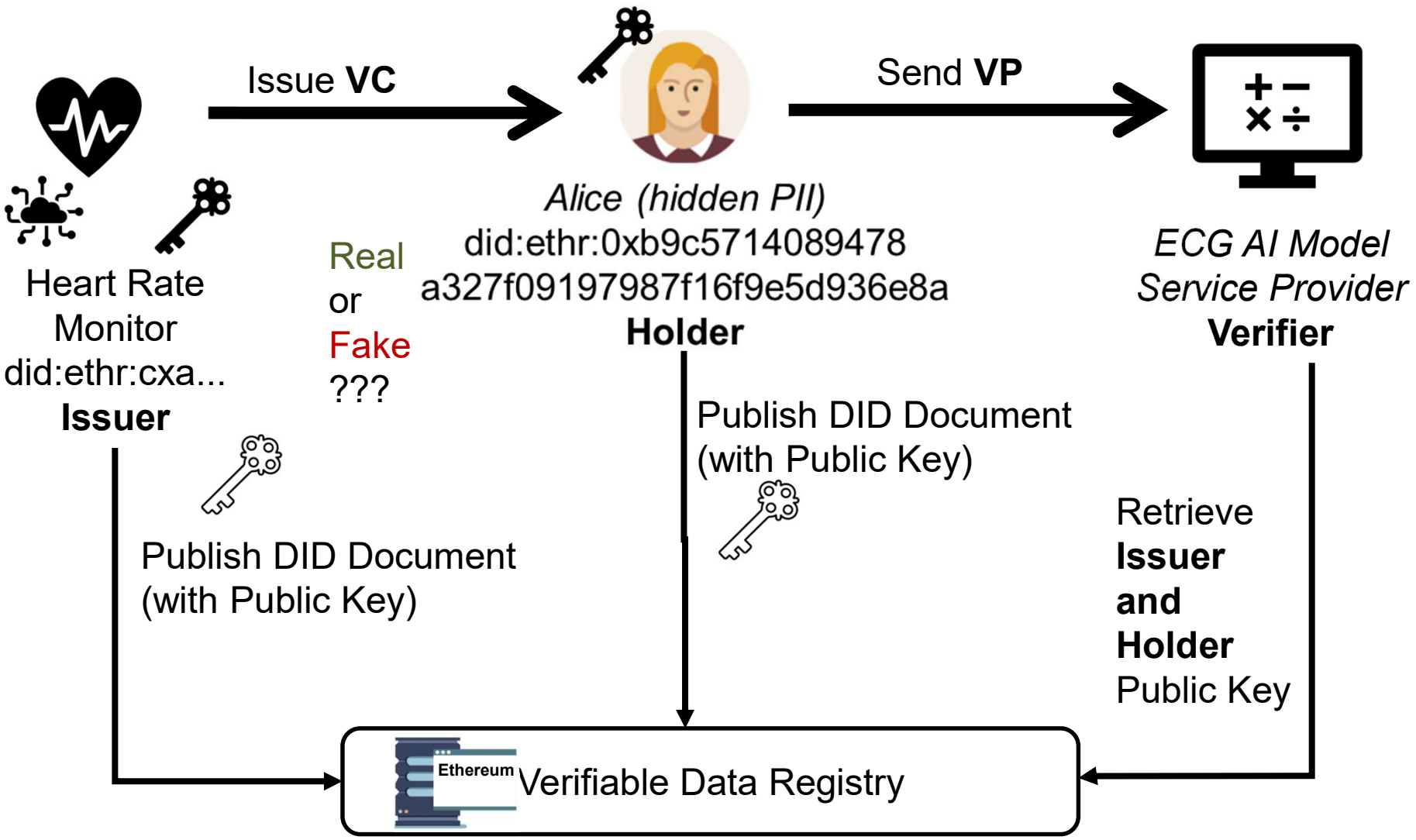
DID methods: 205 listed at diddirectory.com

Use Cases and Trust Issues

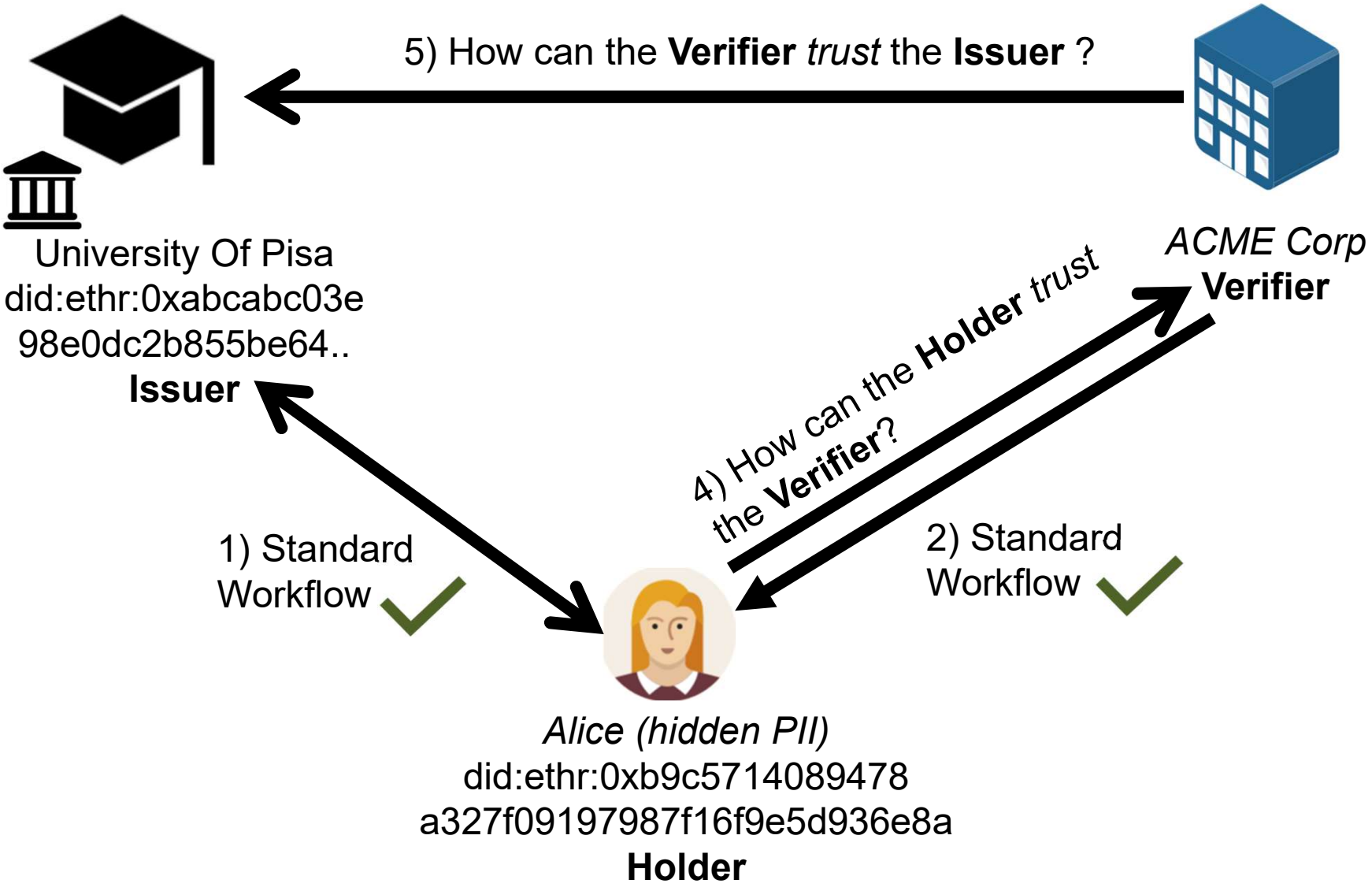
Standard Workflow Use Case 1



Standard Workflow Use Case 2



What is ‘Trust’ in SSI?



How can the Verifier Trust the Issuer ?

University Of Pisa
did:ethr:0xabcabc03e
98e0dc2b855be64..
Issuer

ACME Corp
Verifier

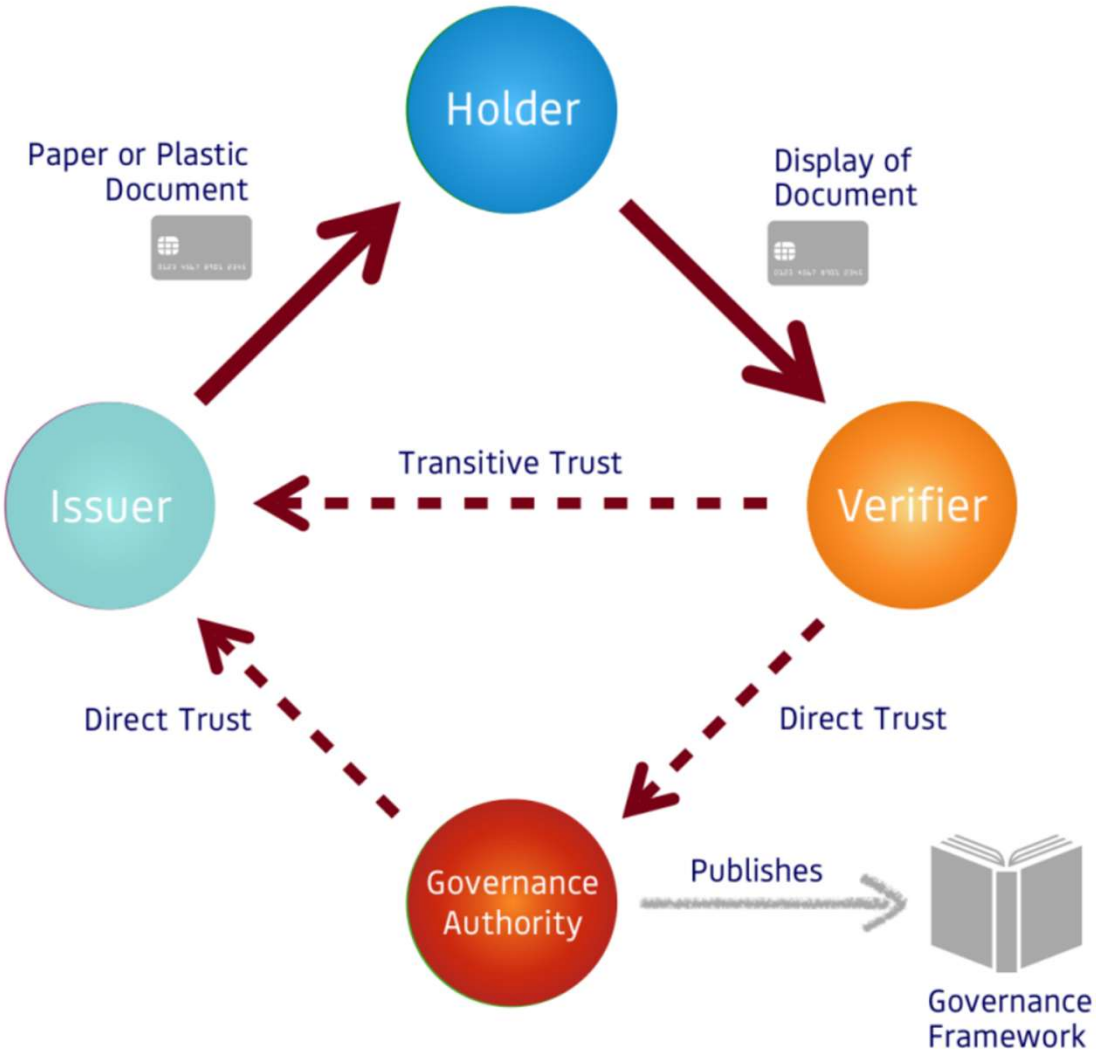
Solutions with different characteristics:

- Root Of Trust Solutions **RoT**
- Decentralized Solutions **DecS**
- Credential Based Solutions **CredBas**

Trust Issues and Measurement

Verifier to Issuer

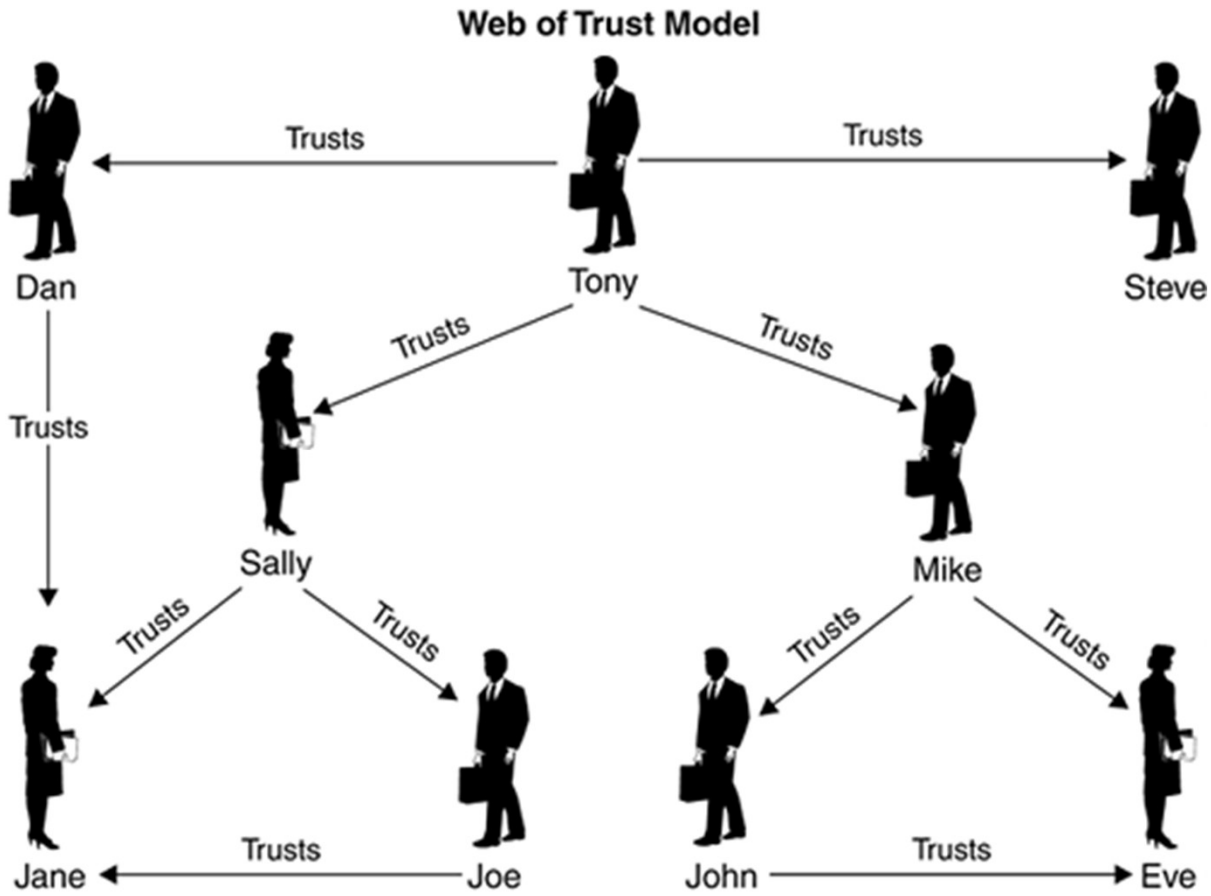
Governance Framework Trust – Trust Diamond RoT



- Domain Specific
- Trust Registry
- Centralized according to Governance Framework

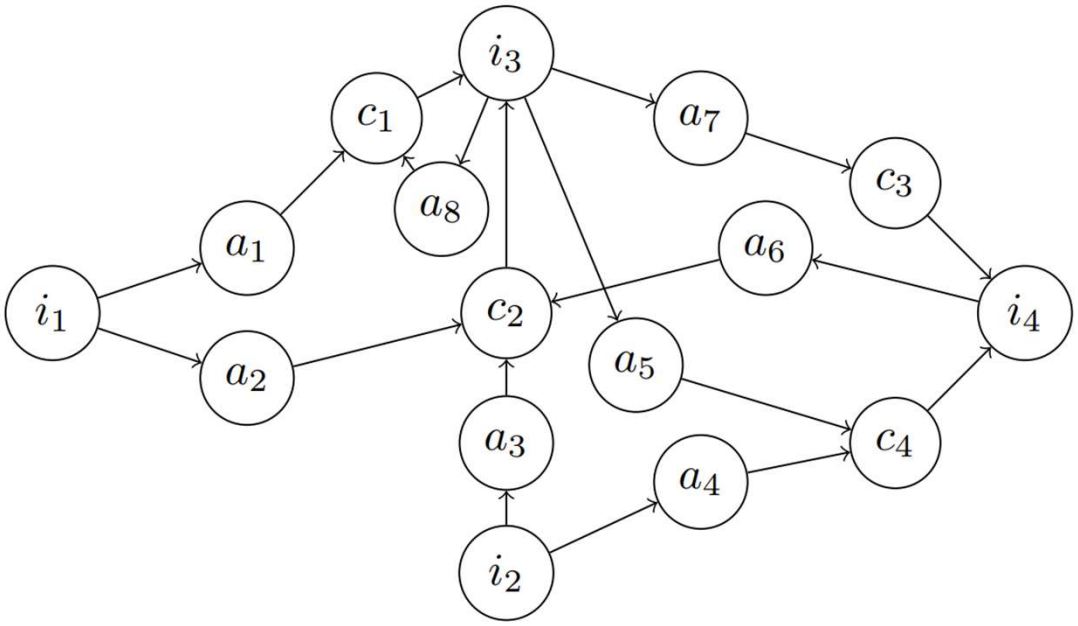
Social Networks and Web Of Trust DecS

- No Governance Framework
- Based on Web Of Trust from Pretty Good Privacy (PGP)



Credential-Based Quantifiable Trust **CredBas**

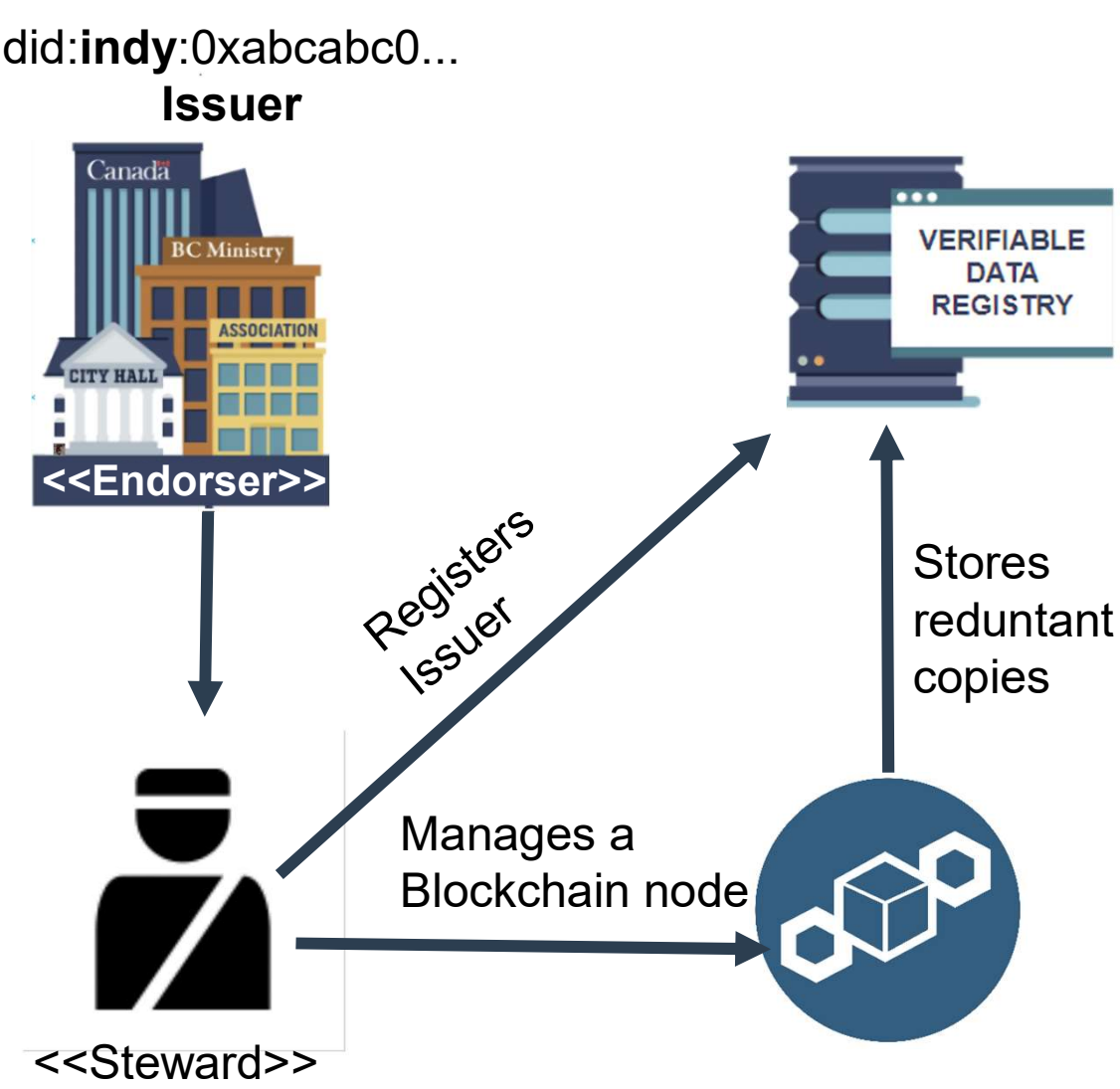
- a_i: attestations (proofs)
- c_n: claims (VCs)
- i_n: identity
- Each identity has an initial list of trusted identities with a score



Trust Frameworks

Verifier to Issuer

Centralized Governance RoT



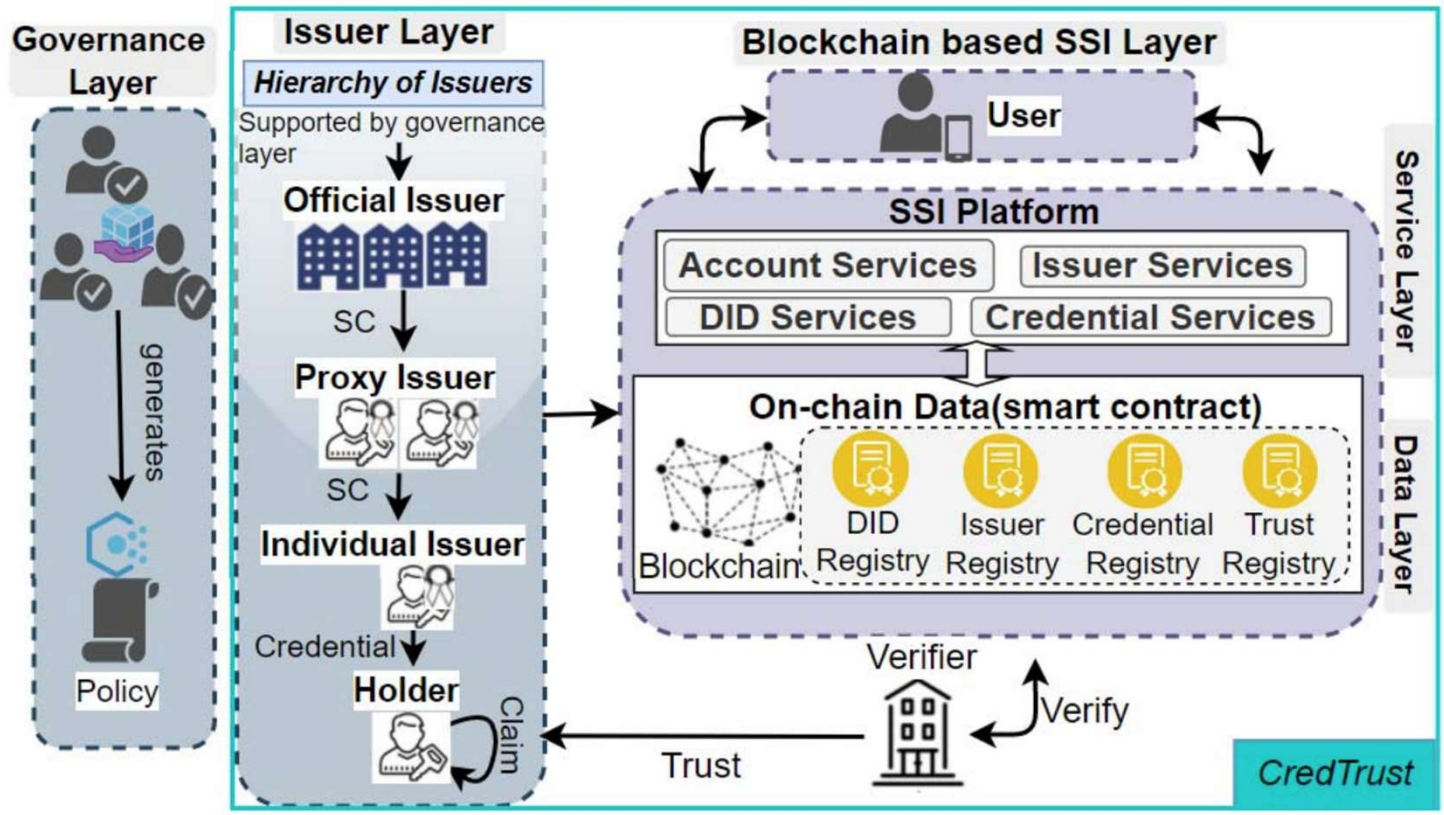
sovrin
identity for all

- **Sovrin Governance Framework**, requires a Legal Entity Identifier
- Charges a Fee to register DID
- Blockchain is public **permissioned**
- Vendor Lock in

https://sovrin.org/mainnet-endorser-did-application-form/

Credential-based Trust Framework: CredTrust I

RoT + CredBas

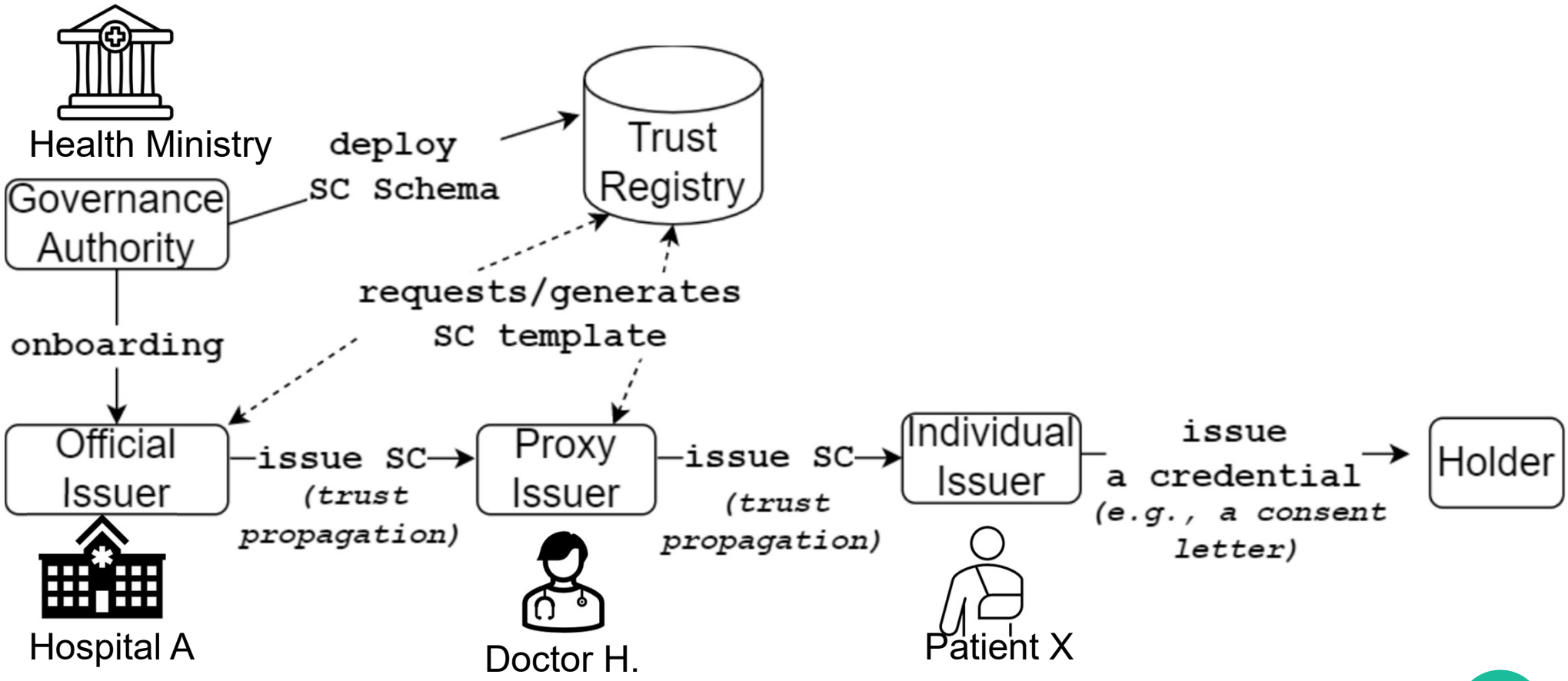


R. Mukta et al. "CredTrust: Credential Based Issuer Management for Trust in Self-Sovereign Identity."
doi: 10.1109/Blockchain55522.2022.00053

Credential-based Trust Framework: CredTrust II

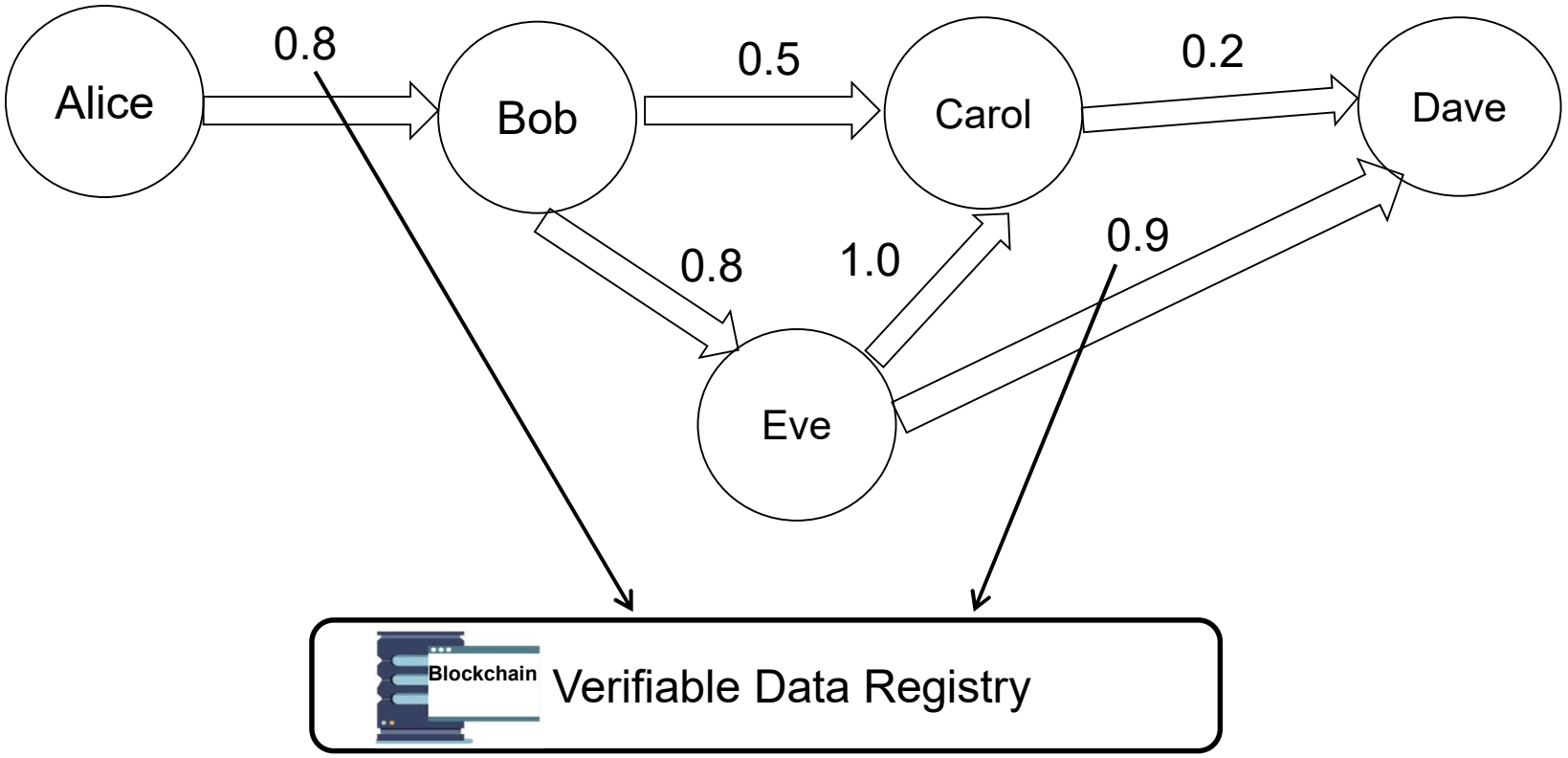
RoT + CredBas

Supporting Credential (SC): specifies the delegated capabilities to an Issuer

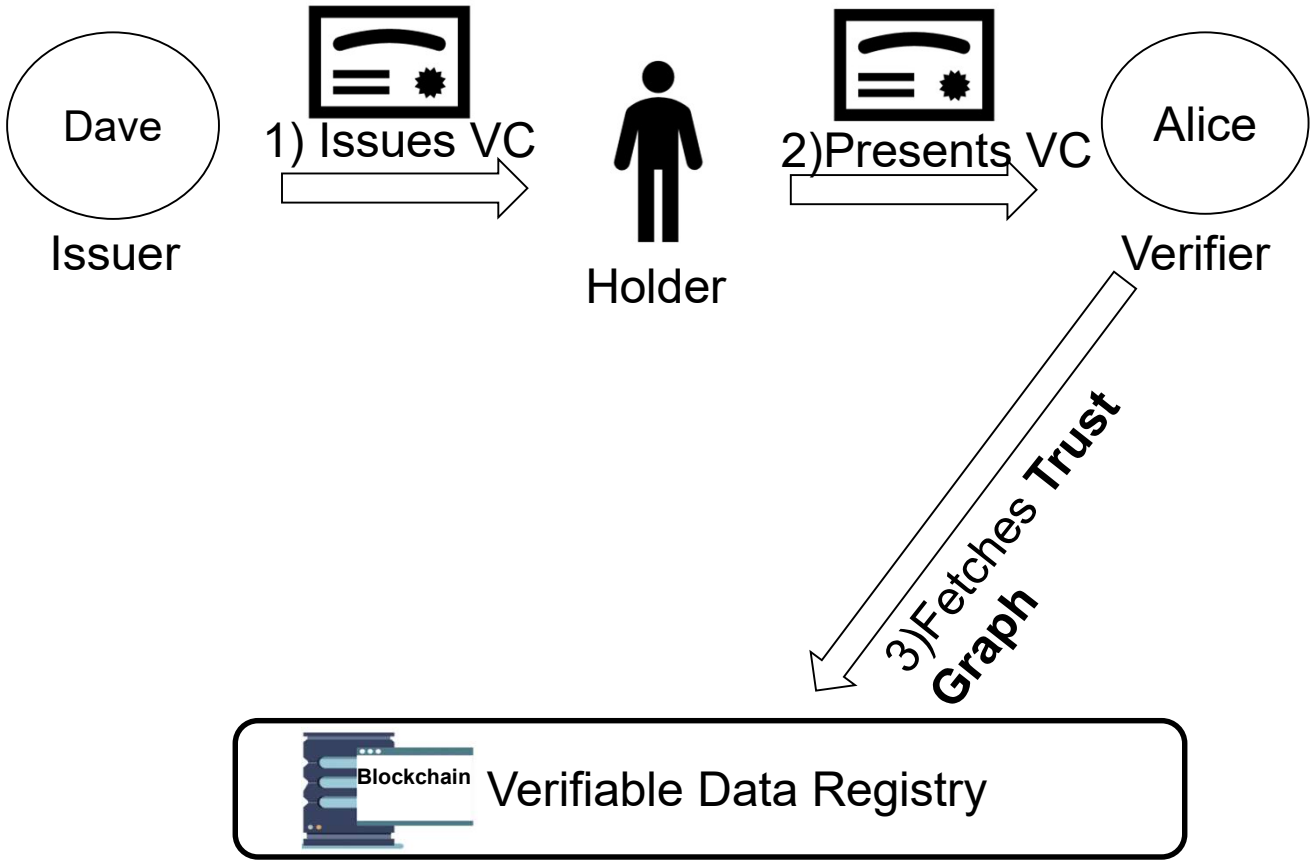


Trust Relationships on Blockchain I DecS

Trust Scores between entities published on Blockchain

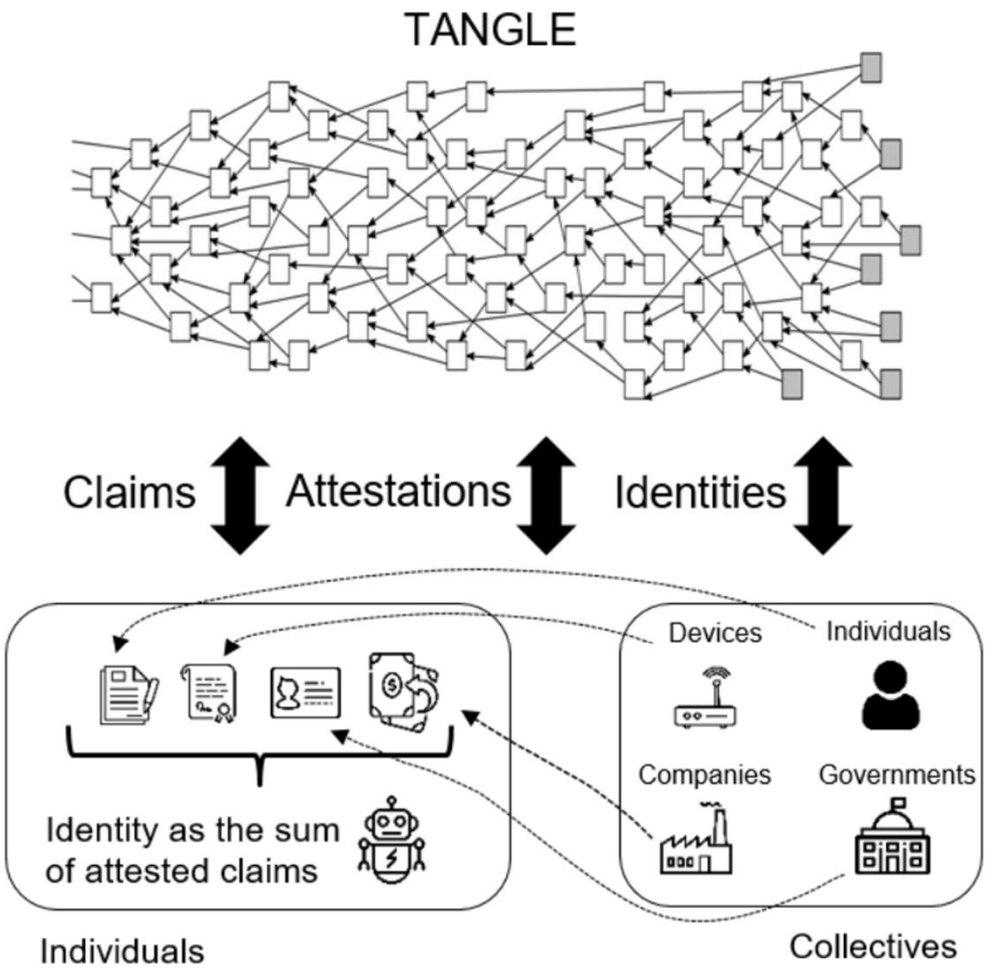


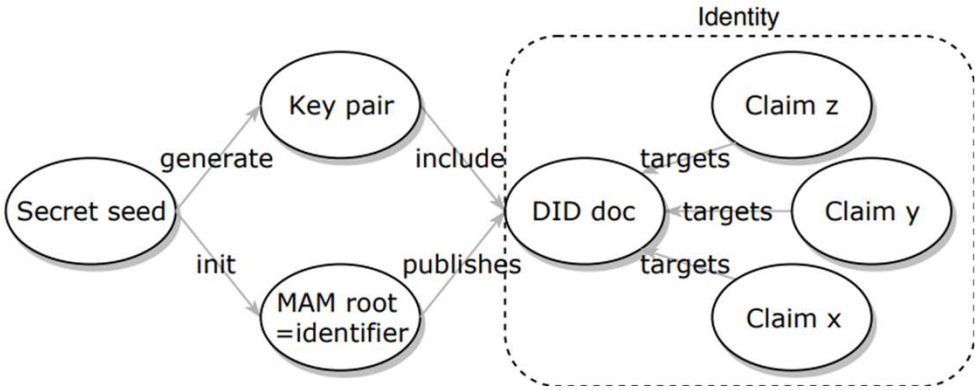
Trust Relationships on Blockchain II DecS



- Calculate VC Trust Score based on:
  - Edges weight
  - Vertex distance
- Fits well on Online Social Networks

IoT and Web Of Trust **CredBas**





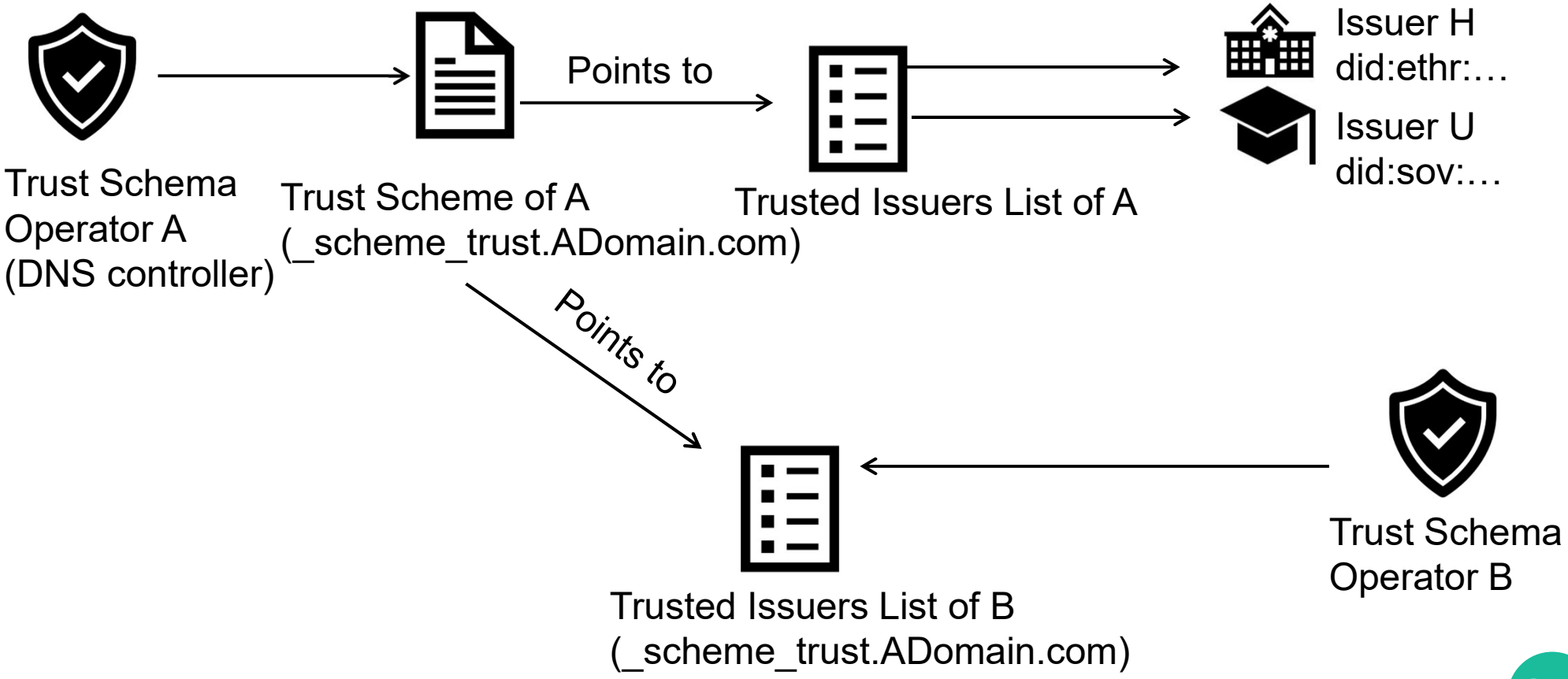
A.Grüner et al. "A Quantifiable Trust Model for Blockchain-Based Identity Management doi: 10.1109/Cybermatics_2018.2018.00250

TRust mAnagement INfrastructure (TRAIN)

RoT

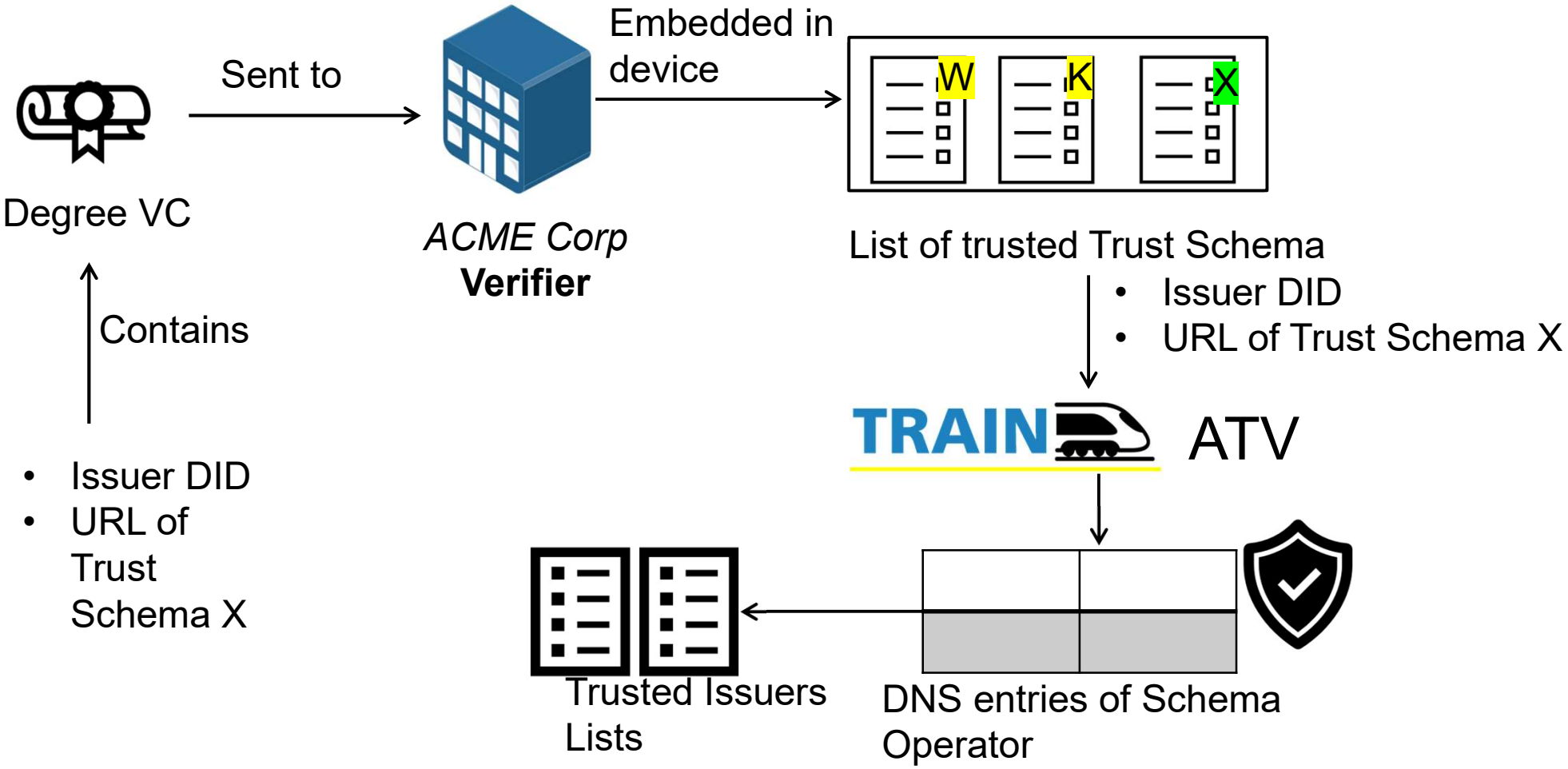
Johnson Jeyakumar et al ," A novel approach to establish trust in verifiable credential issuers in Self-sovereign identity ecosystems using TRAIN doi: 10.18420/OID2022_02

TRAIN



TRAIN Automatic Trust Verifier (ATV)

RoT



Access Control to VC

Holder to Verifier

How can the Holder Trust the Verifier ?

Cardiologist (?)
Verifier

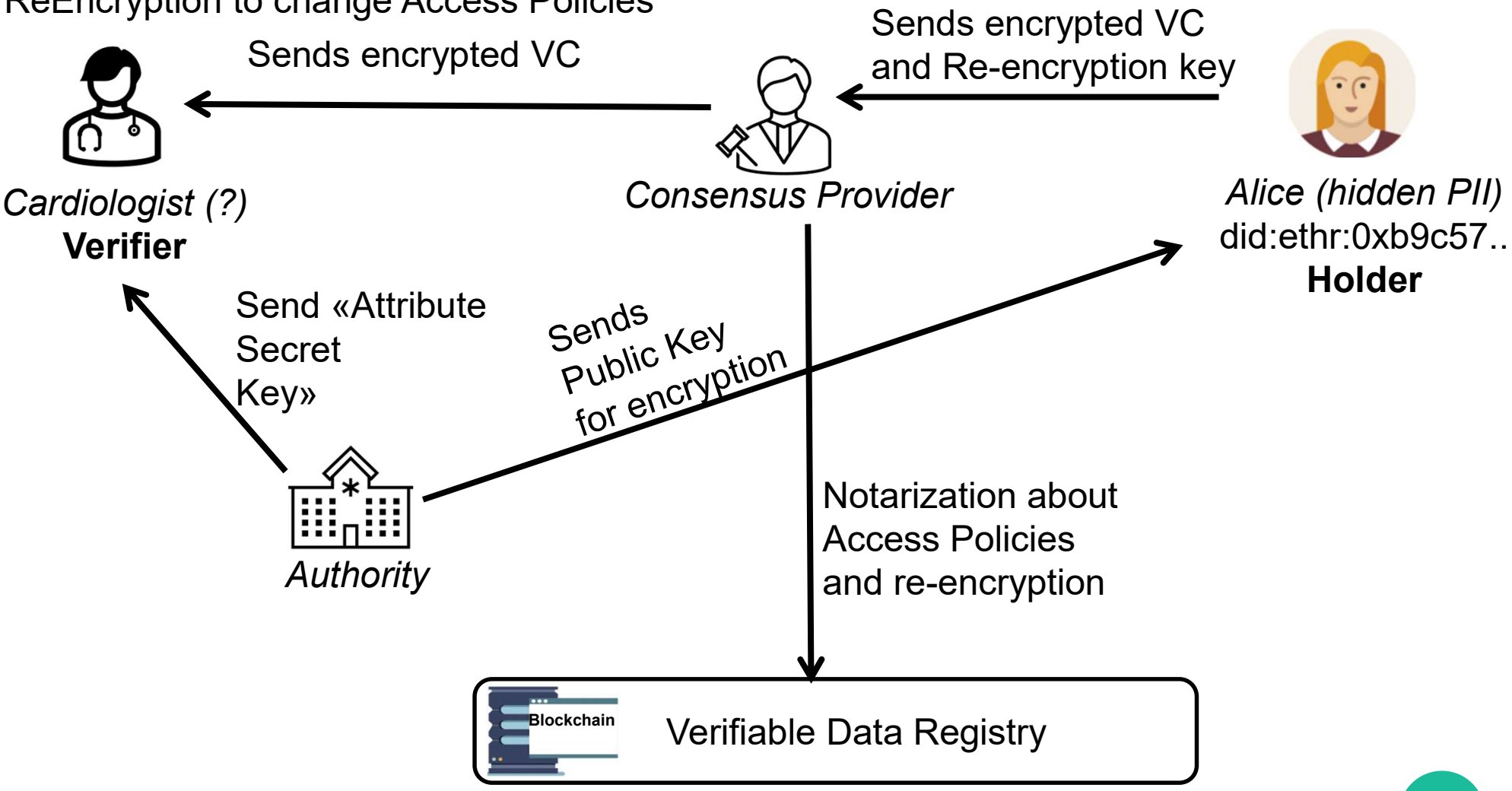
Share Personal Data via VP

Alice (hidden PII)
did:ethr:0xb9c57..
Holder

- Same solutions as before with Holder in the place of Verifier
- Capabilities Access Control

Attribute-Based-Access Control to VCs

- CipherPolicy Attribute-Based Proxy Re-Encryption
- ReEncryption to change Access Policies



Conclusions and Future Works

- Many possible approaches to establish Trust
- Not a definitive one
- Decide early on what kind of solution to choose when creating a SSI-based system

-Future Works

- Guidelines to develop interoperable Governance Framework
- Privacy Preserving Trust Registries
- Selective Disclouse of Trust Ranking in Web Of Trust
- Integration of SSI with Social Networks
- Integration of SSI with Internet of Things

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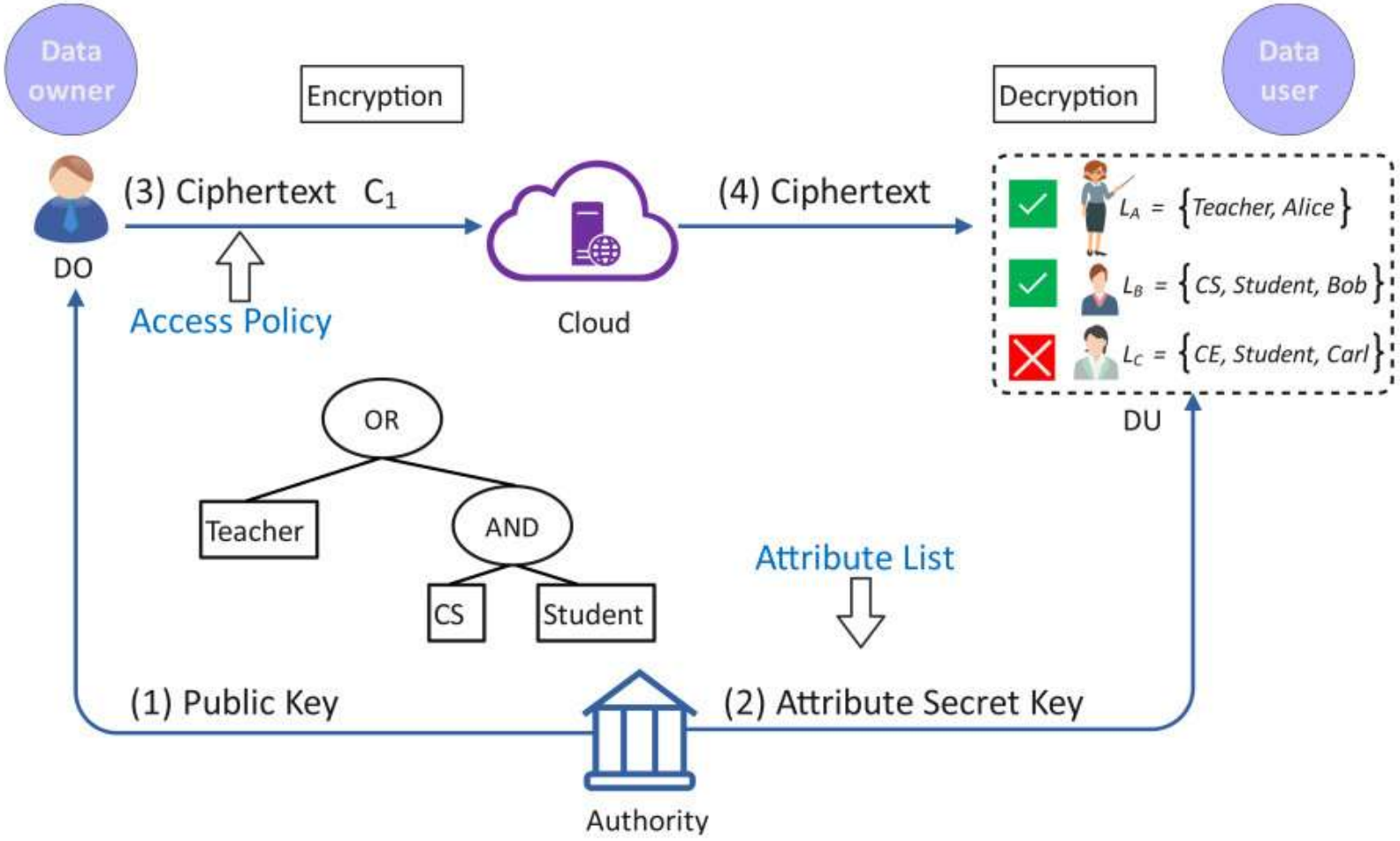
Thank you

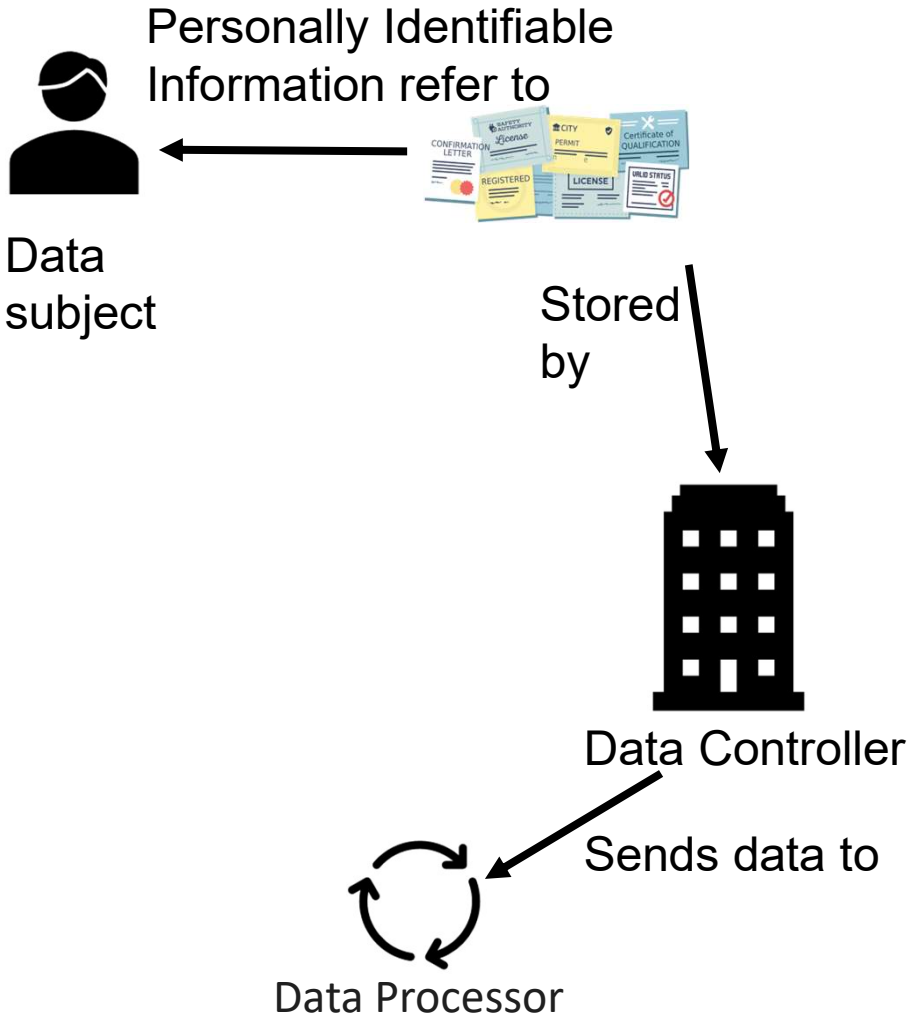
Any question?

Appendix 1


Data owner
Encryption
Decryption
Data user
(3) Ciphertext C_1
(4) Ciphertext
DO
Access Policy
Cloud
L_A = {Teacher, Alice}
L_B = {CS, Student, Bob}
L_C = {CE, Student, Carl}
DU
OR
Teacher
AND
CS
Student
Attribute List
(1) Public Key
(2) Attribute Secret Key
Authority

GDPR, Identity and Sovereignty

Traditional Digital Identity



Self Sovereign Identity