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Educational Development
and Technology

Next Generation Education Ecosystem (maybe)

Gerd Kortemeyer
Educational Development and Technology
ETH Zürich

Pain Points

- Paper-based system for certifications, transcripts, degrees
  - Strongly increasing number of international applications
  - Fake certificates and tests
  - Student mobility (semester abroad, etc.): credit transfer
  - Old records possibly not retrievable anymore, e.g., when data purged or institution no longer existing
- Plethora of educational services (instead of lecturers using monolithic course management systems), e.g., Miro, Padlet, CodeAcademy, Piazza, Slack, Kahoot, Quizlet, publisher homework systems, …
  - Too many usernames/logins
  - Privacy, data security
  - Integration of heterogeneous systems means systems engineering, custom-coding, etc.
- Life-long learning
  - Keeping records from heterogenous institutions
  - Starting from scratch at each institution
  - Leaving behind a breadcrumb trail of data
- “Honey pots:” vulnerability, as breaking into one system can affect large numbers of users

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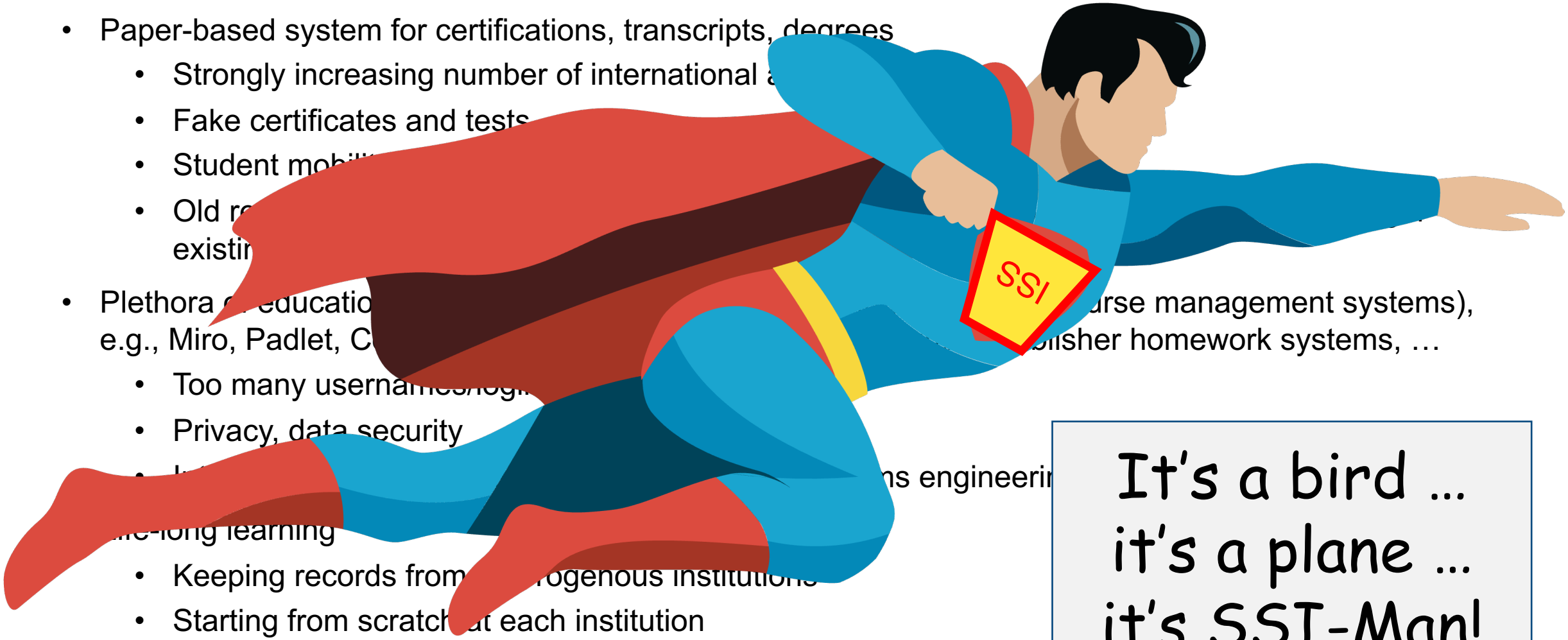


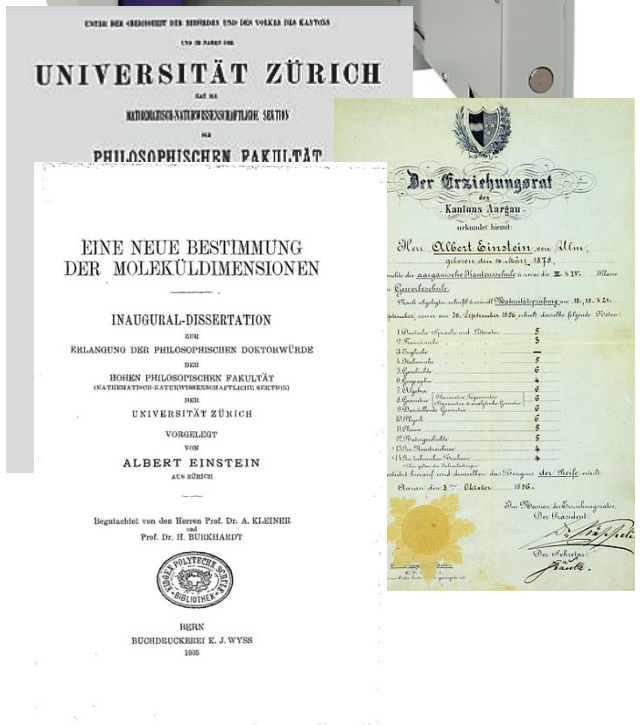
What’s the big idea here?

Main Idea

- Current system:
  - Connection between machines (IP-Adresses)
  - Institution is responsible for keeping degree-relevant data
  - Learner transactional data and artefacts scattered across services
  - Logins with
    - System identities (username, password) or
    - Single-Sign On (SSO), central identity
- Alternative, Self-Sovereignty:
  - Connection between identities (Distributed Identities, DIDs)
  - User is responsible for keeping degree-relevant data (wallet, verifiable credentials)
  - User maintains storage for transactional data and artefacts (cloud agent at agencies)
  - No logins

Main Idea

Physical life



Virtual life

Cloud agent,
hosted at agency

Wallets and other
edge agents

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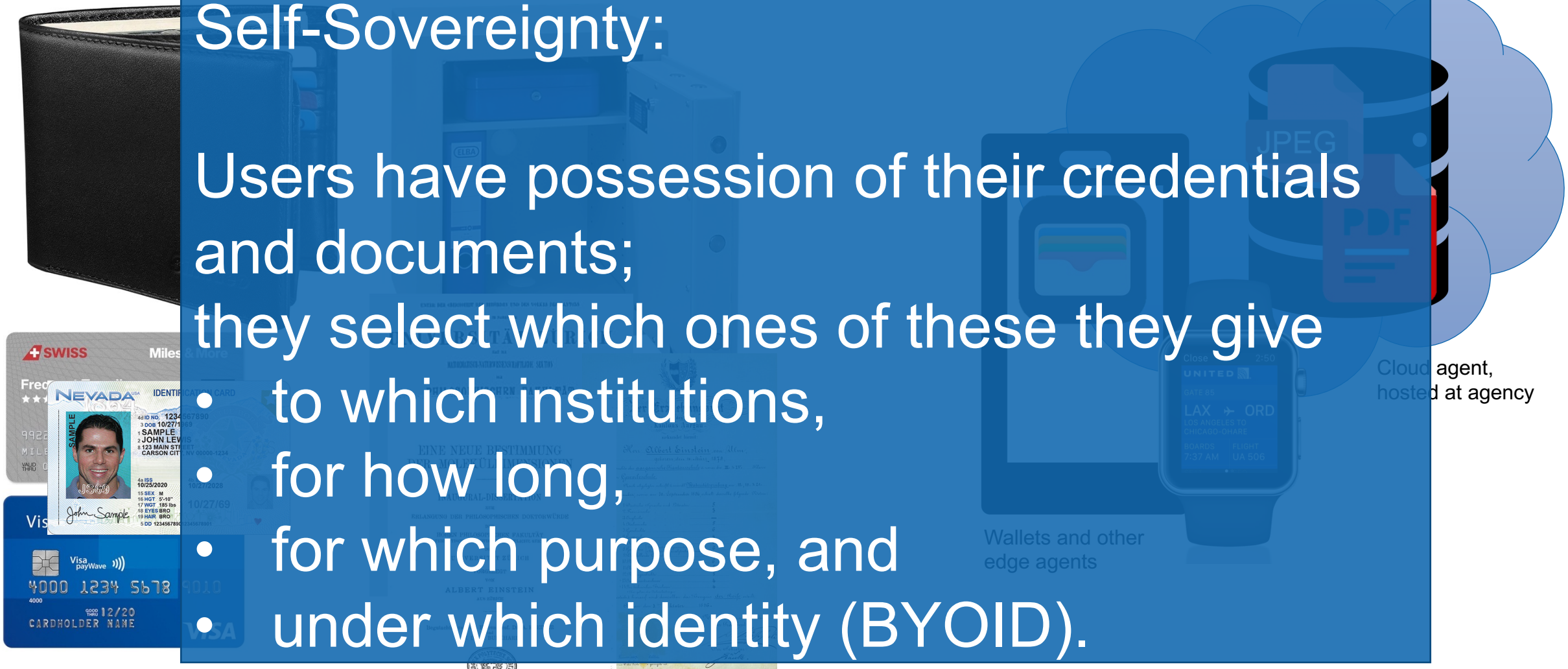
Main Idea

Physical life

Virtual life



Self-Sovereignty:

Users have possession of their credentials and documents;
they select which ones of these they give

- to which institutions,
- for how long,
- for which purpose, and
- under which identity (BYOID).

What are you talking about?

Vocabulary

- Individual: that's you, the physical person
- Entity: an institution, a business, or even a thing ("IoT"), treated same way as an individual,
- Identity: an endpoint for a connection
  - Distributed Identity (DID): equivalent of IP-address
  - Identity assertion: proof of being the particular individual/entity, where absolutely necessary
  - Identity resolution: equivalent of Domain Name Servers (DNS)
- Agent: the application for establishing connections
  - Edge agent: portable, personal agent, e.g., on phone
  - Cloud agent: same thing in the cloud, hosted at an agency
- Credential: equivalent of diplomas, passports, membership cards, tickets, contracts, …
  - Credential holder: the individual or entity to whom the credential is made out
  - Credential issuer: the individual or entity who issues the credential
  - Verifiable Credential (VC): issuer, holder, and content can be verified against a ledger
- Wallet: where Verifiable Credentials are stored and managed

User Model and Ecosystem

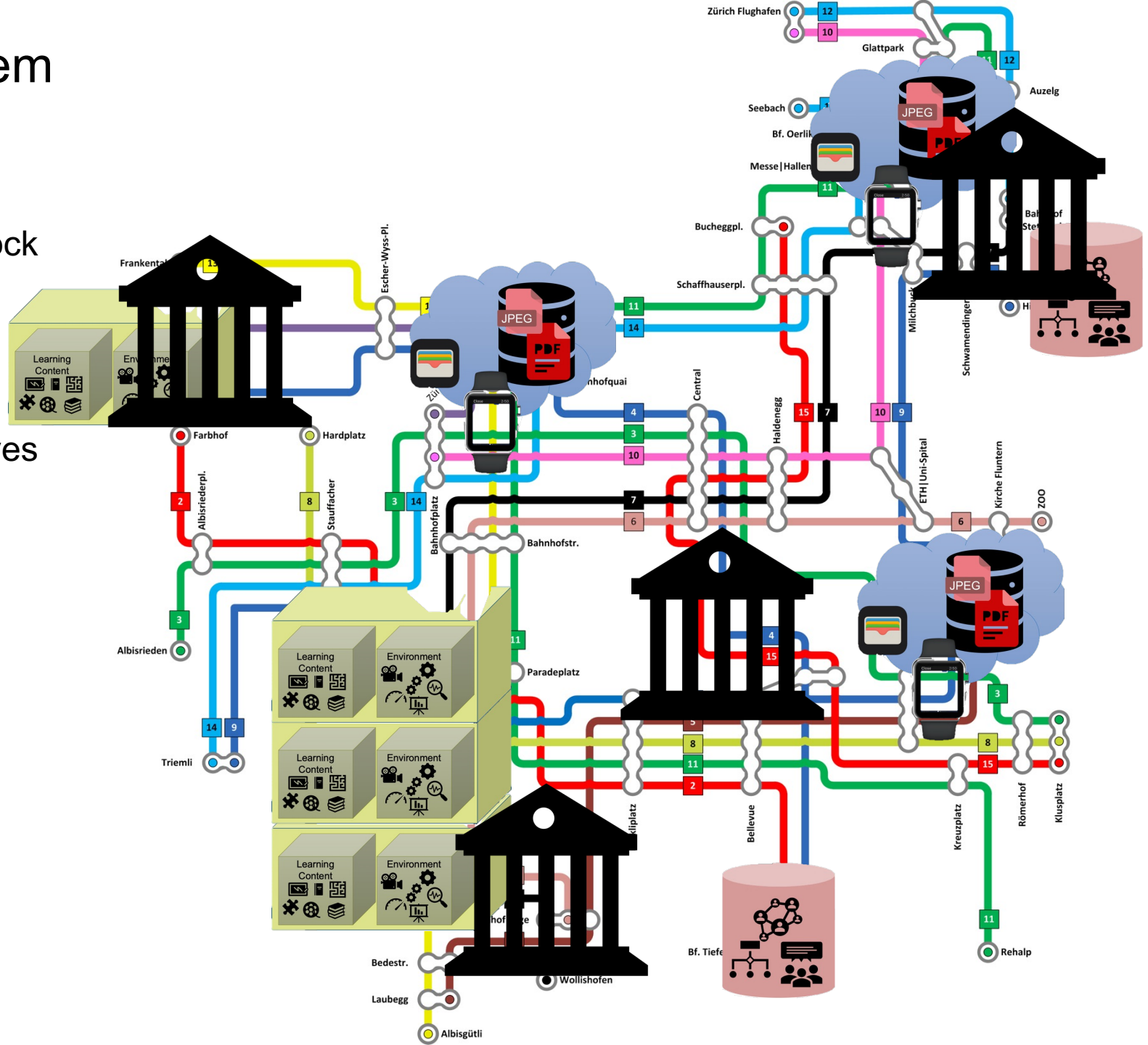
User Model and Ecosystem

- General wallets and data storage, which are also used in other ecosystems
  - will also have flight tickets, COVID certificates, health records, credit cards, …
  - it is nothing more and nothing less than the user's virtual representation
- Different companies worldwide may act as cloud agencies for the agents of the users
  - international competition
    - users can move between hosting companies
  - some basic hosting may be offered for free by the governments

User Model and Ecosystem

- The users move around and dock to educational experiences, services, and institutions
- It takes a village!
- Just like a physical person moves around a downtown,
  - going into stores,
  - the post office,
  - the railway station,
  - a cinema,
  - a restaurant, …

  and conducting transactions (“connections”)



User Model and Ecosystem

- When buying a coffee at Starbucks, they usually ask for a name for the order
- Most baristas in the States don't understand "Gerd", resulting in "Greg", "Gerald", or even "derg"
- Might as well just say "Joe" or "Fred"
- Doesn't matter!
- The transaction of ordering and getting a coffee ("connection") works with any (unique) identity ("distributed identity")
- Just need to somehow associate "Fred" with me ("DID resolution") to get my cup of coffee

User Model and Ecosystem

- I could pay for my coffee with cash (“credential”)
- Has
  - an issuer (Swiss Federal Bank)
  - a holder (I am actually holding it)
  - content (ten Francs)
- All of that works while I am “Fred”
  - Very few connections require identity assertion
    - e.g., showing your COVID certificate **and** ID-card

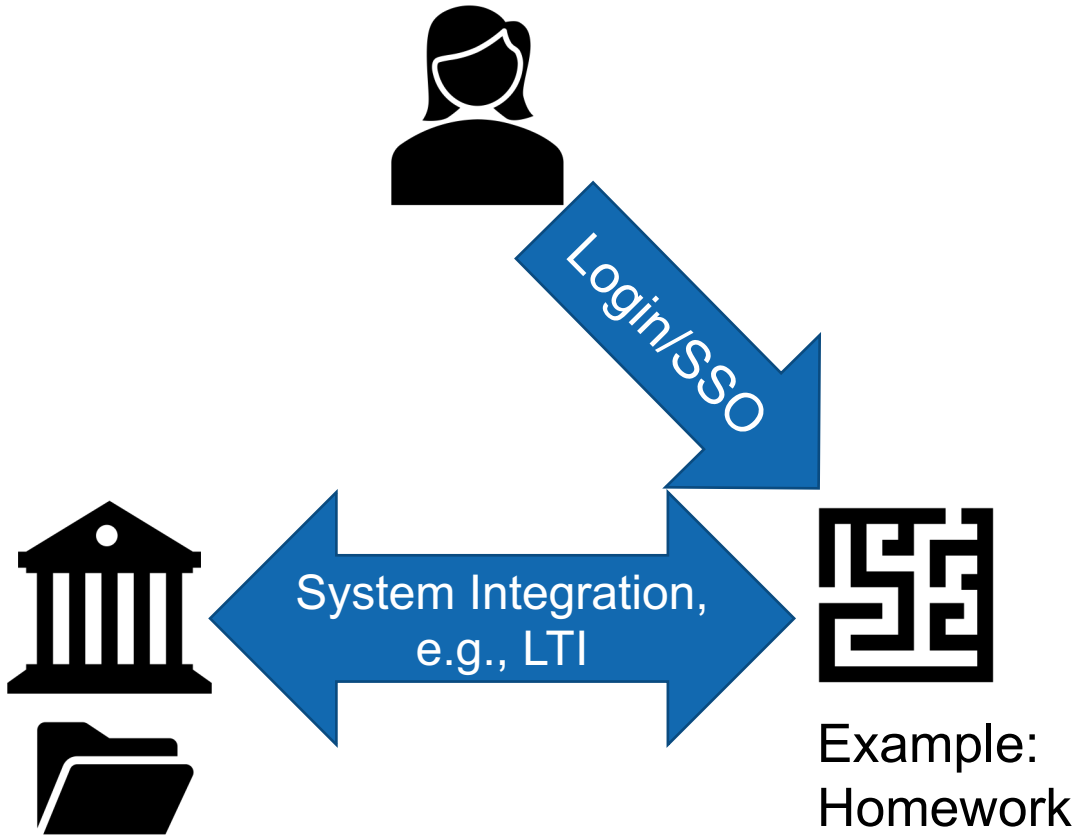
User Model and Ecosystem

- The ecosystem will have services
  - recommenders
  - content repositories
  - catalogs
  - recruiters
  - scholarship organizations
  - publishers
  - universities
  - schools of continuing education
  - testing organizations
  - university offices
  - …

  that users connect with

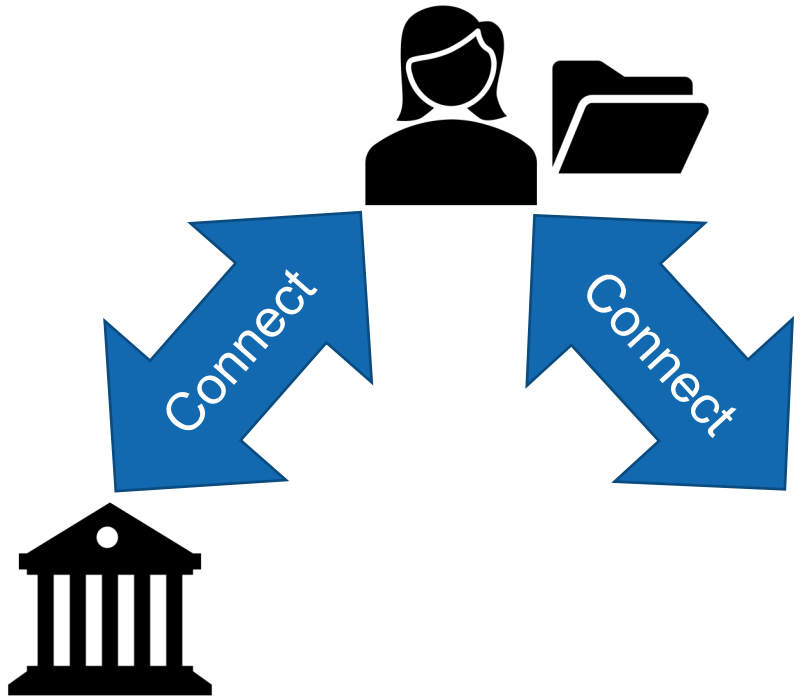
User Model and Ecosystem

Current Model



Example:
Homework
Service

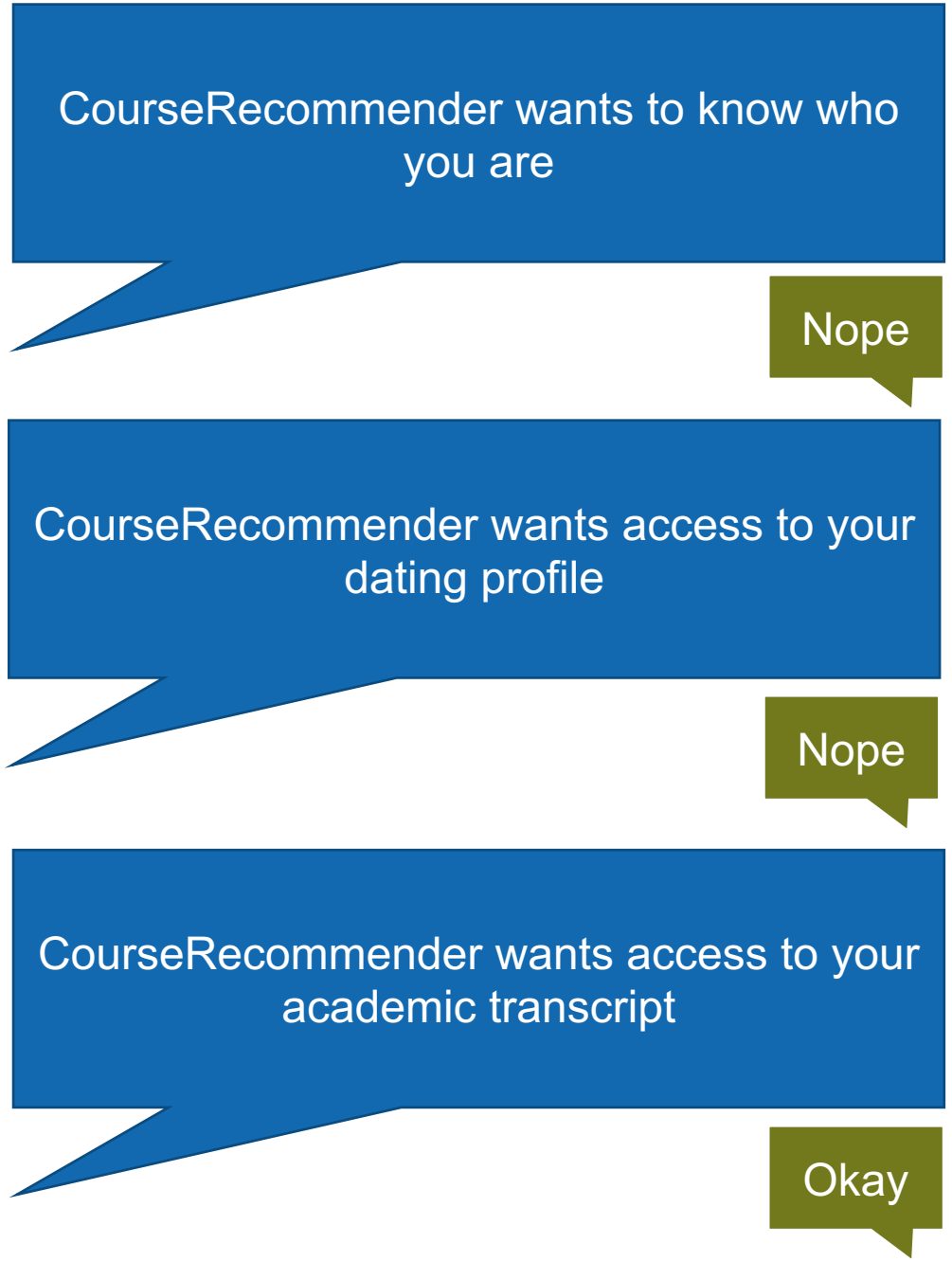
Self-Sovereign Model



Example:
Homework
Service

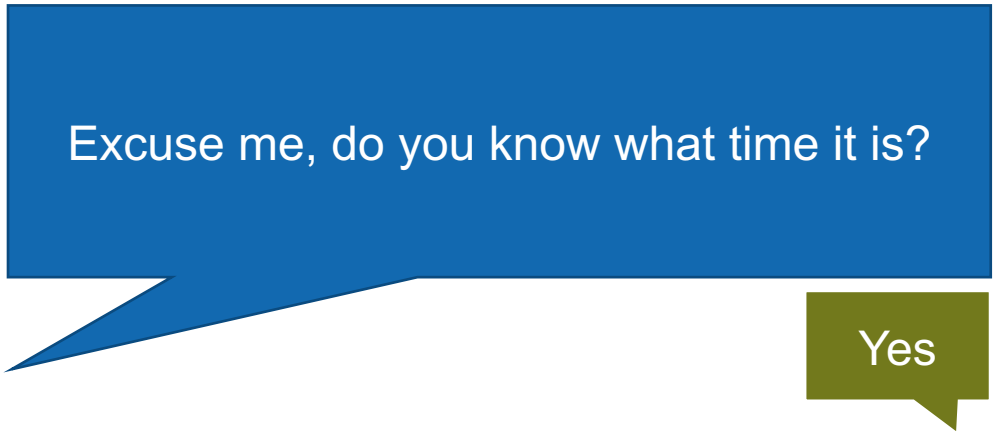
User Model and Ecosystem

- Services only get what the user reveals



User Model and Ecosystem

- Even “zero-knowledge proof” – user proves that they have knowledge of a certain value without revealing what the value is



User Model and Ecosystem

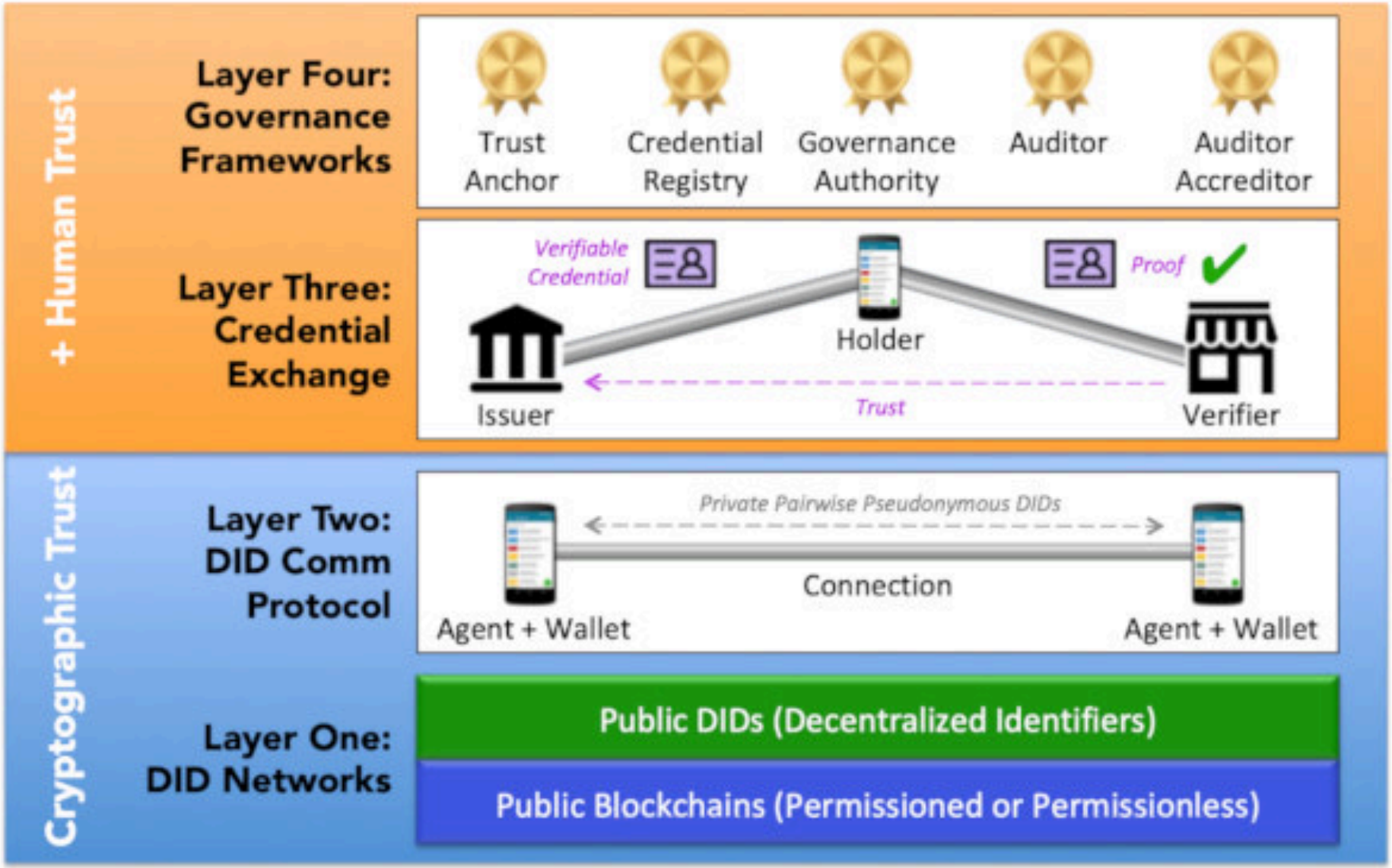
- Educators can use “open market” cloud services in their courses without having to worry about data security and privacy
  - no honey pots
- System engineers do not need to worry about system interfaces and integration

What it takes

Layers

Not just technology

Need to put a number of things into place for the Self-Sovereign Identity stack to work



Source: Sovrin Glossary, adapted by D. Reed

Layers

- Technology:
  - Crypto layer: federated blockchain, DID-resolution – companies like IBM
    - copies of blockchain at partner universities, SWITCH, etc.
  - Edge agent: user can choose use (almost) any wallet, e.g., Apple
  - Cloud agent for user: user can choose where hosted, e.g., at SWITCH or with T-Systems
  - Cloud agents for services and institutions: needs to be developed
  - …
- Human:
  - Governance:
    - Accreditation institution: equivalent of SwissUniversities in each country
    - Service providers: similar to App Store management, needs mechanism
    - Identity assertion: proof of being the particular individual, where absolutely necessary
  - Specification of verifiable credentials (data model): SwissUniversities, etc.
  - …

Isn’t that kind of a tall order?

Tall Order

- Establishing an ecosystem can take a very long time
- … or happen *very* quickly with commercial or political will
- Examples:
  - Wallet payment system – strong commercial interests
  - COVID certificates – strong political will, “green field”

Tall Order

- Transactions are contactless and at arm's length

Tall Order

Not perfect:

- Still needs special agent app
- Still need to verify being the individual the old-fashioned way
- Should be in some “normal” wallet together with digital ID-card

Tall Order

- Might need some kick-starting
  - Intake services for old-style educational credentials
    - Compare getting foreign vaccination record “converted” to Swiss COVID Certificate
      - For degrees along the lines of the German ANABIN
      - For credits along the lines of the American Transfer Articulation Database
      - For micro-credentials along the lines of the European Union Approach
  - Working with existing structures and governance
    - Accreditation and trust via existing national accreditation authorities like SwissUniversities
    - SWITCH
- Needs some agreements
  - W3C Verifiable Credentials for Education Task Force

A Life-Long Learning User Story: Albert

A Particular Use Case

- 1879*-1896: **Citizen**, Kingdom of Württemberg, **German Empire**
- 1889-1894: Luitpold Gymnasium (left without degree), Munich, German Empire
- 1896: **Highschool diploma**, Cantonal School Aargau, **Switzerland**
- 1896-1901: **stateless**
- 1900: **Federal teaching diploma**, ETH Zurich, **Switzerland**
- 1901-1955†: **Citizen**, **Switzerland**
- 1905: **Ph.D.**, Uni Zurich, **Switzerland**
- 1908-1909: **Lecturer**, University of Bern, **Switzerland**
- 1909-1911: **Lecturer**, University of Zurich, **Switzerland**
- 1911-1912: **Lecturer**, University of Prague, **Austro-Hungarian Empire**
- 1911-1912: **Citizen**, **Austro-Hungarian Empire**
- 1912-1914: **Lecturer**, ETH Zurich, **Switzerland**
- 1914-1918: **Citizen**, Kingdom of Prussia, **German Empire**
- 1914-1933: **Professor**, Humboldt University, Kingdom of Prussia, **German Empire**
- 1918-1933: **Citizen**, Free State of Prussia, **Weimar Republic**
- 1933-1955†: **Member**, Institute for Advanced Studies, Princeton, **United States of America**
- 1940-1955†: **Citizen**, **United States of America**

How can he prove to Princeton that he has a doctorate?

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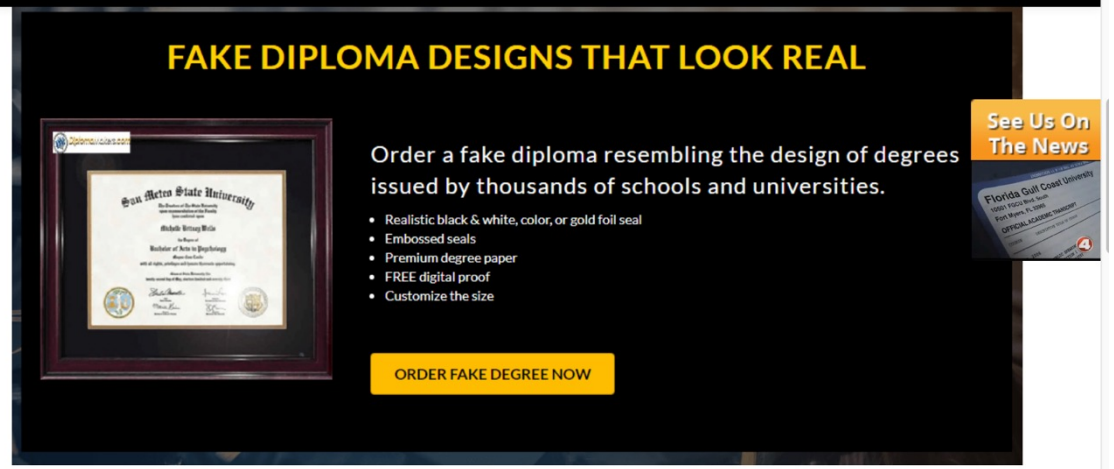
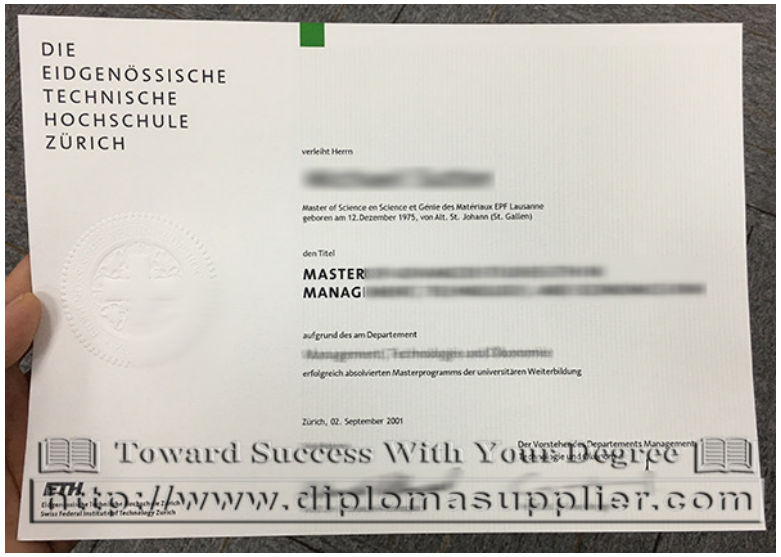
DiplomaMakers.com HOME STORE SAMPLES SCHOOLS SERVICES TESTIMONIALS FAQS ABOUT CONTACT

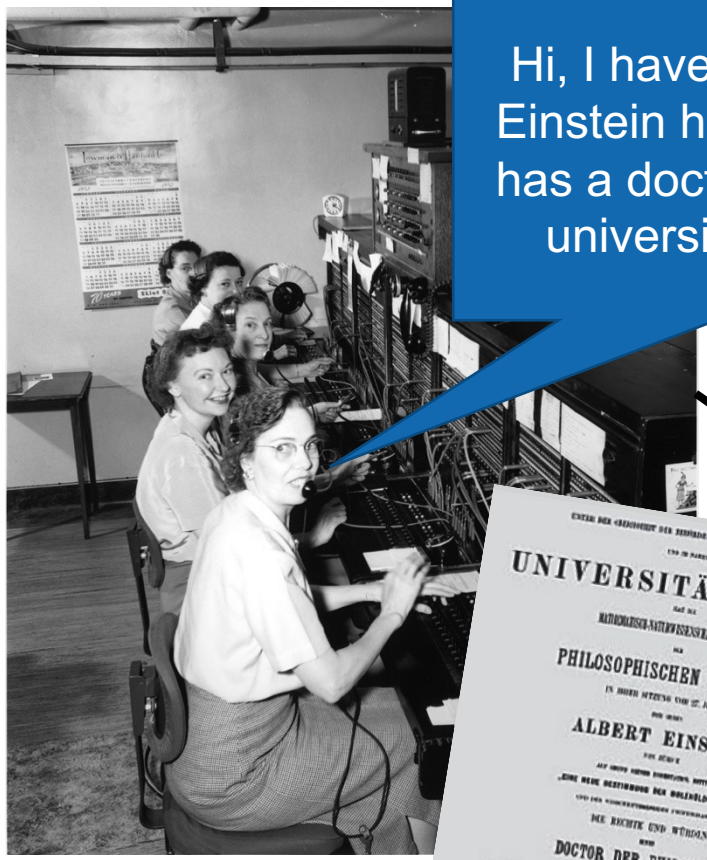


How to Get a Fake Degree from a Real University

Here are the simple steps on how to make a fake degree certificate either tailored to Bachelor's, Master's, or Associate degree.



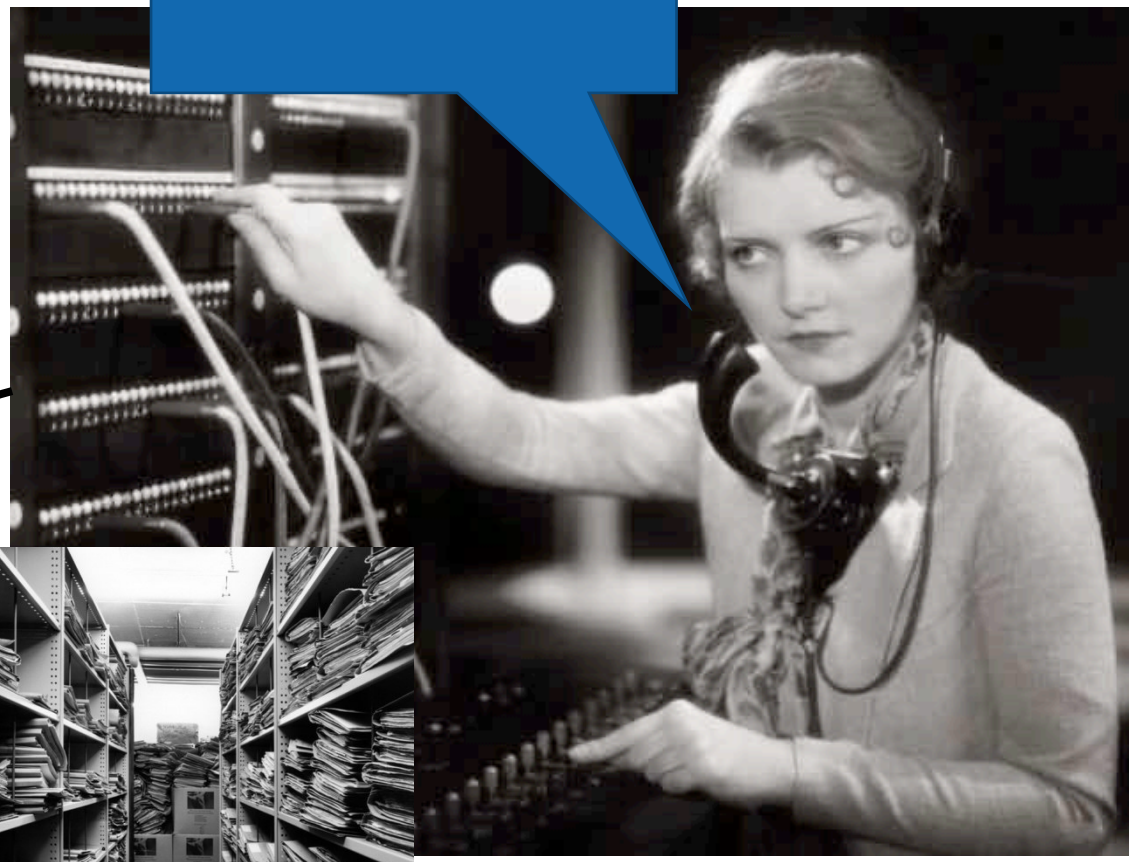
Proof in the Olden Times



Hi, I have this guy Albert Einstein here. He says he has a doctorate from your university. Is that so?

Princeton HR

Albert who?



University of Zurich Registrar

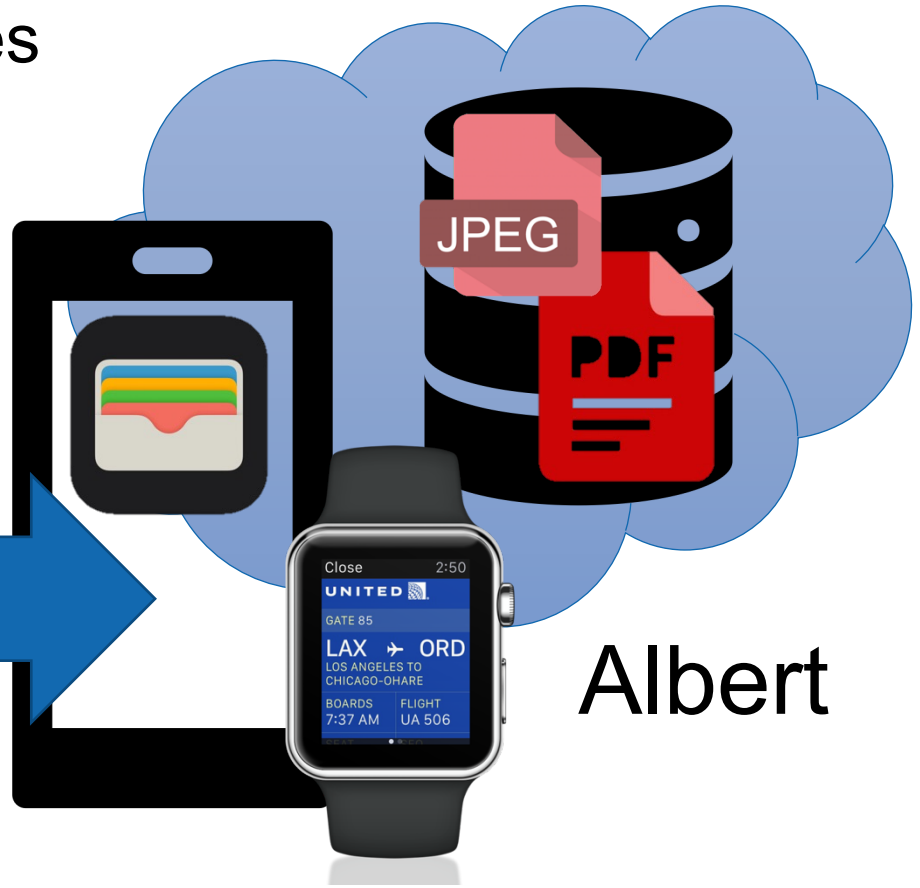
Proof in the Olden Times

- With the Uni Zurich in Switzerland, that is a clunky way of getting proof, but not really a problem
- But: let's imagine a questionable institution in a questionable country (like Germany was at the time)
  - The institution knows that Albert applied at Princeton
    - possible professional setbacks if not accepted
  - The institution might not exist anymore
  - The institution might have lost the records
  - The institution or country might intentionally withhold the records
    - holding data ransom
    - holding back the individual
  - The institution or country might intentionally tamper with the records
  - The country's authorities could find out that Albert is in the United States
    - possible repercussions to friends and family back home
    - persecution

Proof in Modern Times

Uni Zurich

Doctoral Certificate



Albert

Crypto Identifiers

Ledger

Time →

Proof in Modern Times

Proof in Modern Times

- Institution does not know that Albert applied
- Country does not know that Albert is in the United States
- Independent of the continued existences of the institution or the institution’s records
- Blockchain not under control of institution, tamperproof
- Certificate is under control of Albert, but tampering would be detected

Some More Examples

More Example Use Cases

- Student gets course credit
  - Student successfully completes course credits at an accredited institution
  - Institution issues verifiable credential for course credit
- Student applies for degree
  - Student releases all relevant credits to institution
  - Institution issues verifiable credential for degree
- Student does assignment on a service of an accredited external provider
  - Student establishes connection with service
  - Student does assignments
  - Transactional and portfolio data go into cloud agent
  - Provider issues verifiable credential of completion

More Example Use Cases

- Student applies for study program
  - Student releases relevant verifiable credentials and possibly selected portions of portfolio
  - Institution automatically verifies credentials
  - Institution evaluates application
  - If accepted, institution issues verifiable credential of enrollment

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Gerd Kortemeyer
Director of Educational Development and Technology

ETH Zurich
Educational Development and Technology
Haldenbachstrasse 44
8092 Zürich, CH

gerd.kortemeyer@let.ethz.ch
http://gerdkortemeyer.com/