TRANSMUTE

Introduction to

Decentralized Identity

&

Self-Sovereign Identity

INTERNET IDENTITY WORKSHOP #IIW33 | OCT 2021

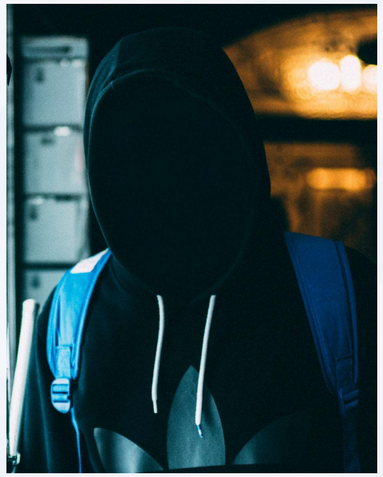
WHO?
WHAT?

What is an **Identity**?

WELCOME

These are **our** identities

HOSTS



Karyl Fowler
CEO @Transmute
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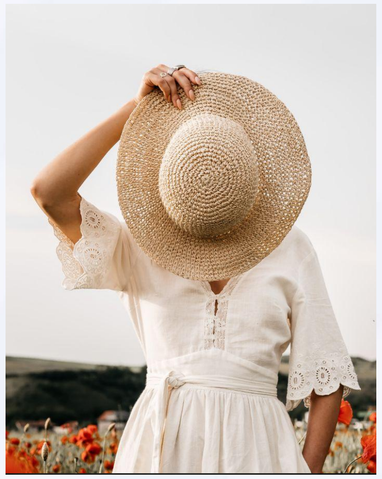

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AGENDA

1. Identity? Who IS that?
2. Two Tales: Self-Sovereign Identity
3. SSI: The Movement
4. SSI: The Technology
5. Pairing the Two: Uses & Applications
6. Where are we now?
7. Where are we going?
8. Learn More & Get Involved
9. Audience Q&A

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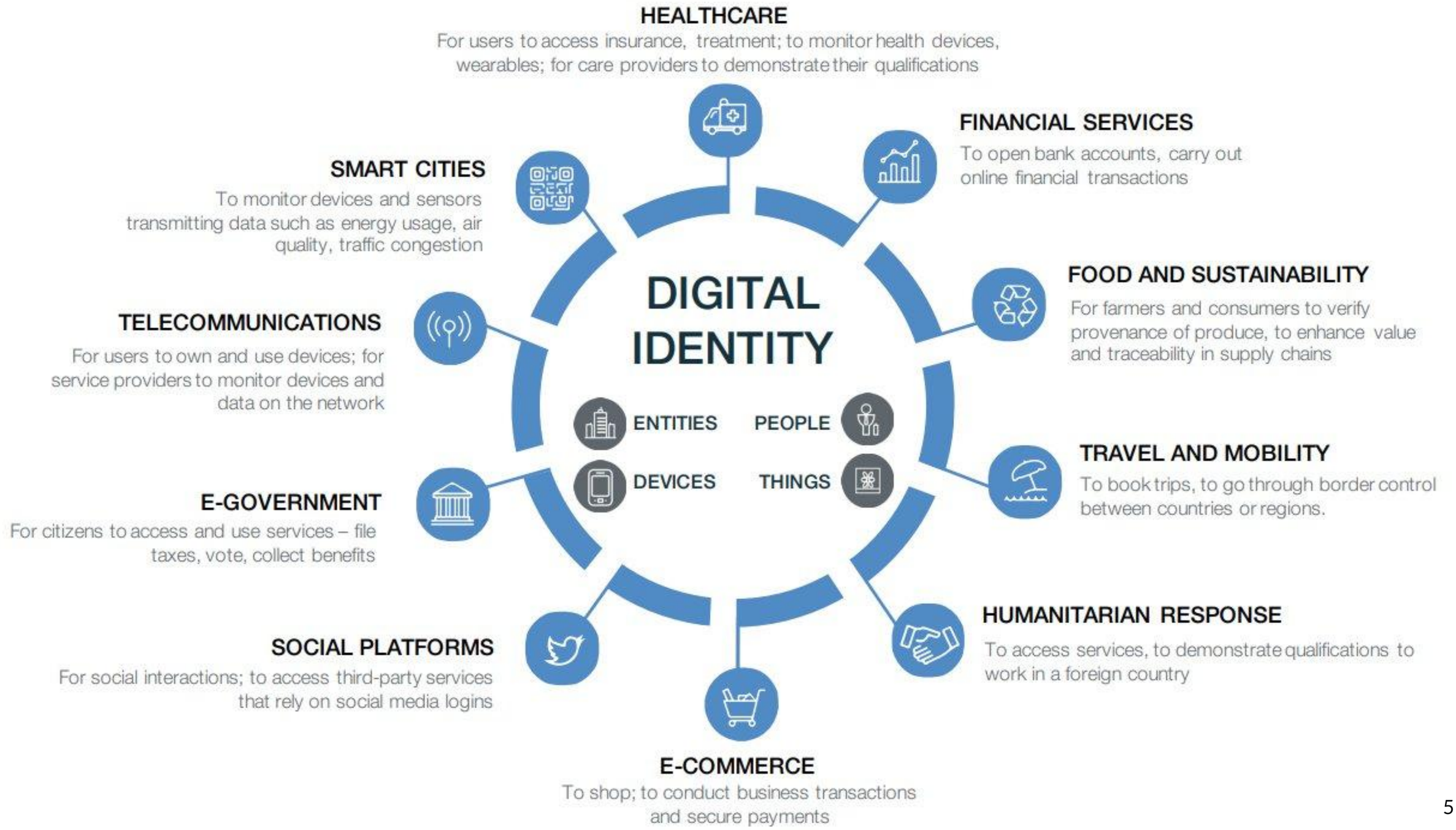
10. *Appendix: Reference material + links*

Who or what has an **Identity**?



GRAPHIC CREDIT: World Economic Forum: Identity in a Digital World

WHICH IS WHICH?

Decentralized vs. SSI

Decentralized Identity

Decentralized identity is **a trust framework in which identifiers, such as usernames, can be replaced with IDs** that are self-owned, independent, and enable data exchange in a zero-trust, infrastructure-agnostic way.

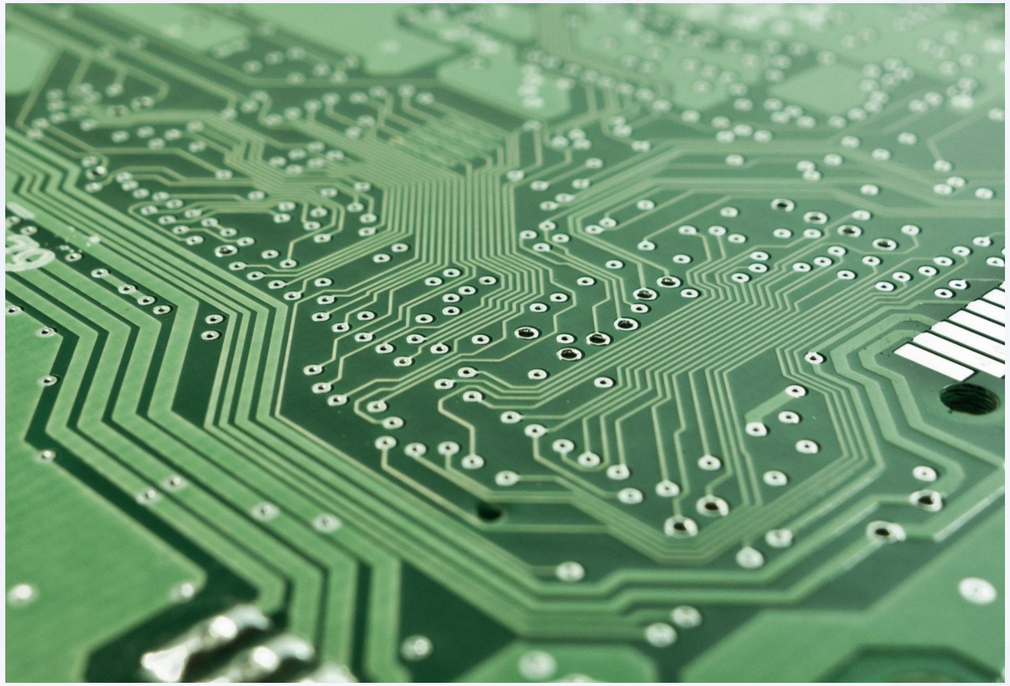
Self-Sovereign Identity (SSI)

Self-Sovereign Identity (SSI) is an approach to **decentralized identity** designed to give individuals control of their digital identities and data.

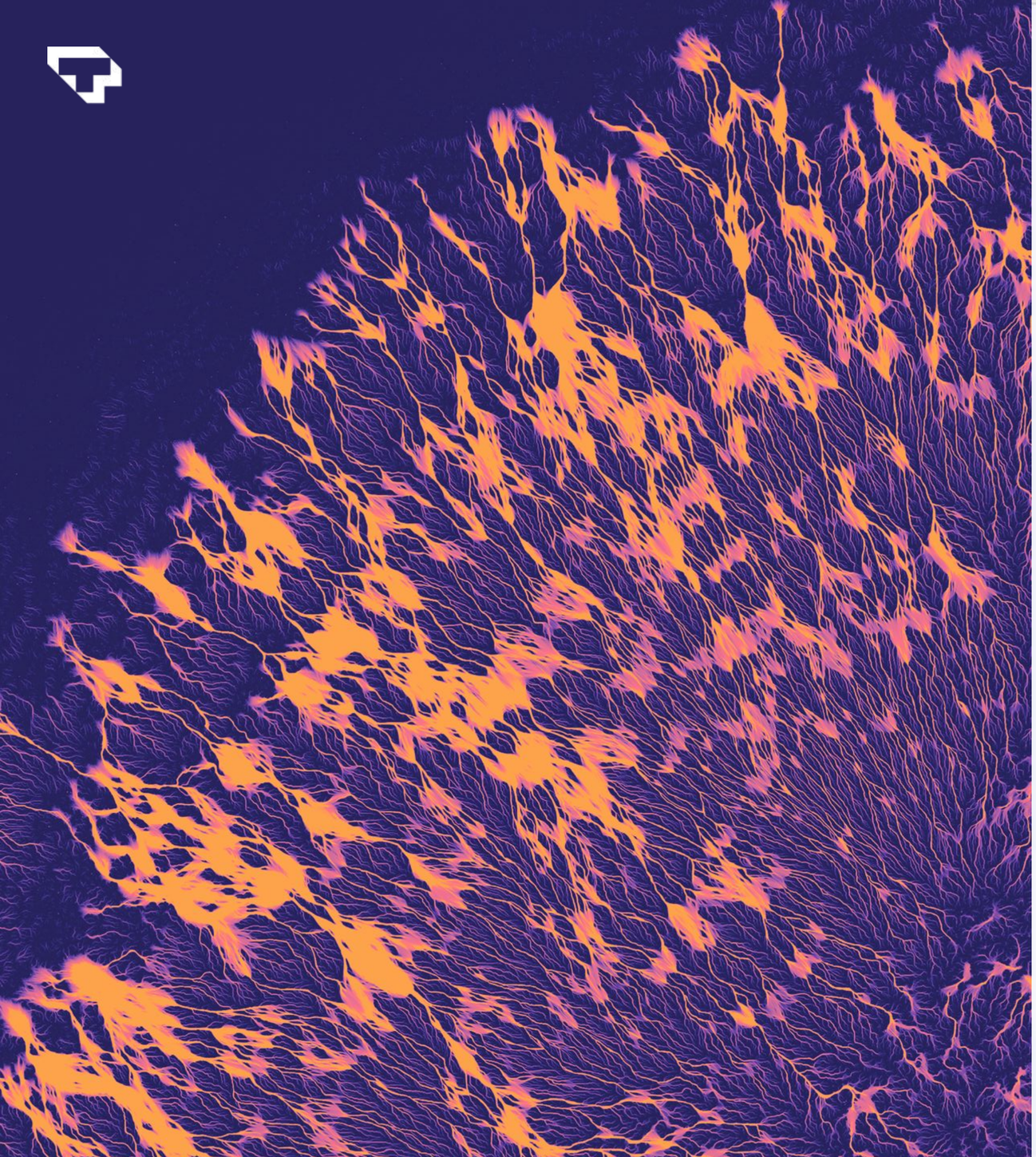
TWO PARTS

Self-Sovereign Identity (SSI)

The Movement



The Technology



SELF – SOVEREIGN IDENTITY

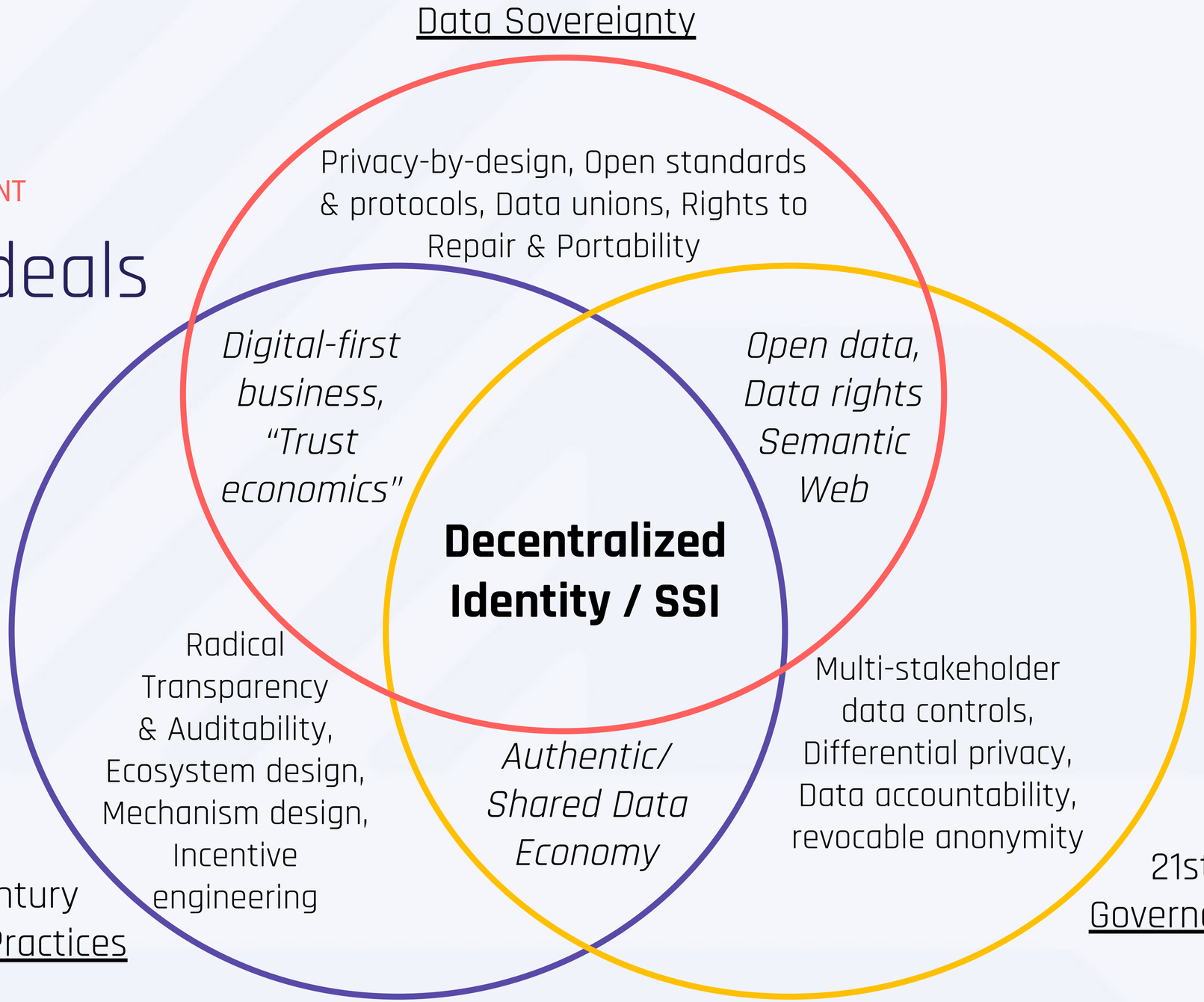
The Movement

Influential writers and essayists:

- **Kim Cameron** ("Laws of Identity", 2005)
- **Doc Searls** (Harvard blogger, co-founded IIW in 2005 with…)
- **Kaliya Young** (…a researcher/educator who gives this talk some years!)
- **Christopher Allen** (RWOTer & author of "10 principles" and of slide #6!)

THE MOVEMENT

Shared Ideals



SLIDE CREDIT: JUAN CABALLERO, INTRO TO SSI

TWO MAJOR TRACKS

Less Identity + **Trustless** Identity

*"Legally-Enabled Self-Sovereign" Identity**

Key characteristics:

- Minimum Disclosure
- Full Control
- Necessary Proofs
- Legally-Enabled
- Clearly-defined **audit** capabilities

Or more properly "Trust Minimized" Identity

Key characteristics:

- Focus on anonymity & strong encryption
- Web of Trust / P2P networks
- "Censorship Resistance"
- Defend Human Rights vs. Powerful Actors (nation states, multi-national corps, mafias, etc.)
- Avoid simply recreating and reinforcing existing structures

- *Originally coined by Tim Bouma (@trbouma) https://medium.com/@trbouma/less-identity-65f65d87f56b*
- *See also Christopher Allen's presentation at Odyssey 2020*

SLIDE CREDIT: CHRISTOPHER ALLEN'S ODYSSEY PRESENTATION 2020

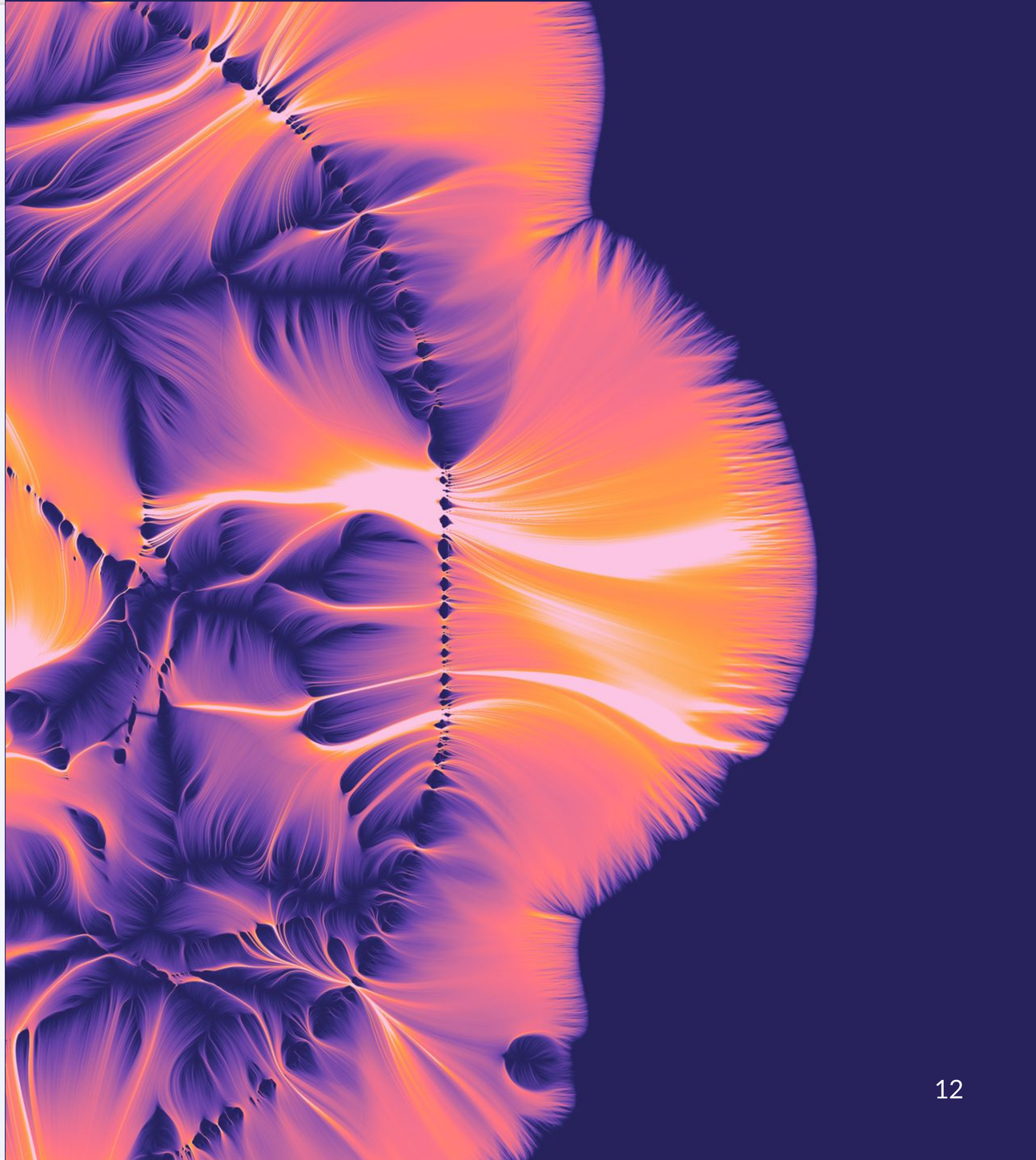
12 foundational principles of SSI

1. Representation
2. Interoperability
3. Decentralization
4. Control & Agency
5. Participation
6. Equity and Inclusion
7. Usability, Accessibility, and Consistency
8. Portability
9. Security
10. Verifiability and Authenticity
11. Privacy and Minimal Disclosure
12. Transparency

SOURCE: PRINCIPLES OF SSI -TRUST OVER IP FOUNDATION

SELF – SOVEREIGN IDENTITY

The Technology



Identity is the gene of software applications.

EXISTING WAY OF DOING THINGS

Centralized Identity

Our “identities” (assembling into “profiles” or artifacts of “identification”) are stored away on the servers of identity providers, which own the structure, the content, and the access rights to everything we do.

They lend us a key, but they can change the locks, or throw away the contents. We are but lowly subjects of the data barons.

See Christian Kameir's project, “Engineering for Identity,” for an argument about how centralization is baked into all the terms we inherit from these paradigms.

Federated Identity

By linking together silos into a “federation,” managers of businesses, platforms and services can outsource the “ID checks” at the door, making them interchangeable and interoperable. Authentication is tricky business, and most relying parties are happy to offload this headache…

…onto ever more powerful middlemen who now hold richer, multi-silo identities on all of us in exchange for this convenience. Single-Sign On makes the data barons into data emperors. The familiar interfaces of OAuth pop-ups and Sharing tabs on mobile OSs are the ligaments stitching together vast empires of deduplication and probabilistic fingerprinting.

PAST WAY OF DOING THINGS CAUSED

Today's Problems

- Usage data collected to create detailed profiles with **all-or-nothing access,** often without any consent, much less **informed** consent
- Who **owns** user data & decides how it's used?
- Difficult to delegate or attenuate access or privileges dynamically or retroactively
- Users **can't control** how their data is secured or shared (or notified if there is a breach)
- Single points of failure and **honeypots** everywhere
- Usernames + Password databases are an attack surface
- **Data bloat:** businesses taking on liability for more data than they need
- There is no identity layer that persists across all systems
- No unified framework for **account portability**
- Scarce **data portability**

SLIDE INSPIRATION: HEATHER VESCENT + KIM HAMILTON DUFFY + KALIYA YOUNG - all previous presenters of this introduction!

LET'S THINK

Considerations

- **Abuse** How do we counter abuses, often by large corporations, such as coercion to reveal information or data collection?
- **Accountability** How do we protect the marginalized, disenfranchised, and otherwise vulnerable?
- **Advocacy** How can we convince people of the needs or demands of privacy?
- **Community** Can we have privacy while also facilitating connections and supporting communities?
- **Culture** What are different cultural expectations about privacy? How can we support them?
- **Ownership** How can we empower users to understand, access and control their data?
- **Perspective** How can we view privacy in different ways?
- **Portability** How do we create a healthy and moral environment for privacy competition, and ensure intercompatibility
- **Regulation** Is regulation sufficient to protect privacy?
- **Relationships** How do we selectively release information in different relationship contexts?
- **Security** How do we ensure systems are private and secure? Are these systems auditable or legally valid?
- **Technology** What kinds of technology platforms can we use, adapt or develop?
- **Usability** How do we create privacy and security without sacrificing usability?

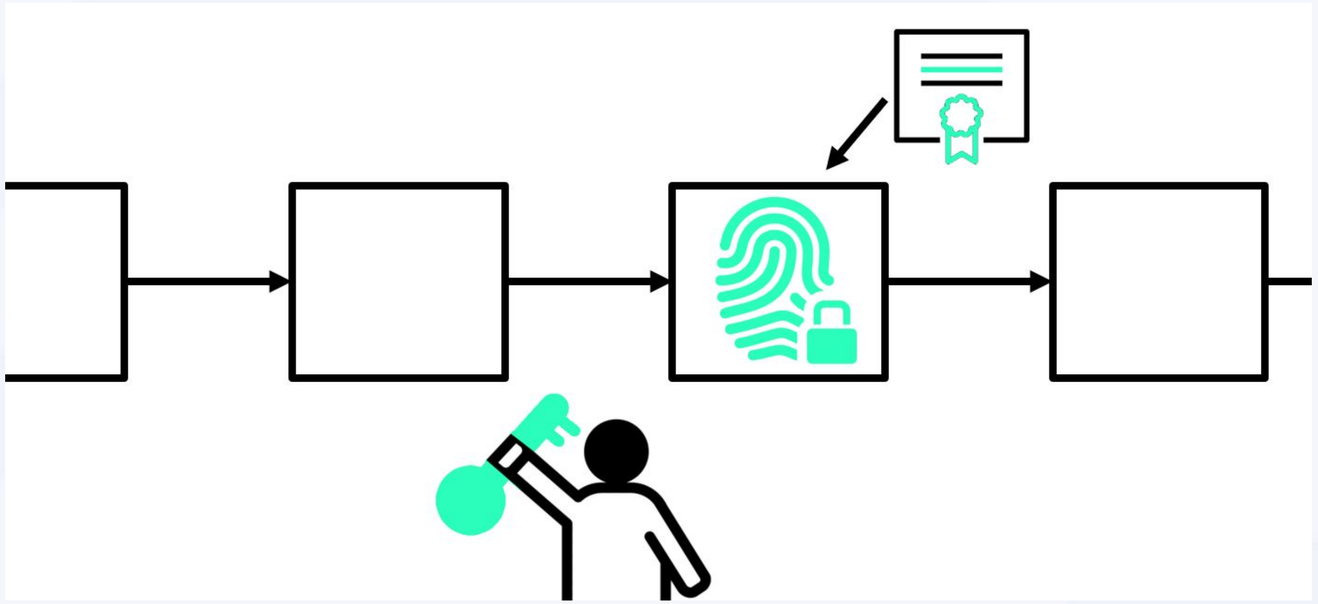
WEB 3.0 WAY OF DOING THINGS

Decentralized Identity

Blockchains and DLTs aren't perfect, but they're the **best**, stablest, and most production-ready system we have today for publishing user-managed cryptographic keys **at scale**.

Different systems optimize for different variables (performance, privacy, total cost of ownership, forward-stability) but there are always **trade-offs**.

Some **innovative** work (such as KERI, Sidetree, web KMS and DKMS) are pushing the key-management envelope on other ways.



Tech Foundations

Decentralized Identifiers (DIDs): self-controlled, digital fingerprints assigned to people, entities, or things

Verifiable Credentials (VCs): Like "files" but with granular controls baked in. Timothy Ruff's "shipping container" analogy is apt.

Trusted Resolvers ("Mini DNS") can connect systems to the "local namespaces" of DID methods, while Trusted **Registrars** can even handle delegated CRUD operations.

Secure Data Storage ("lockers/vaults"): Extend granular controls to underlying data, creating DID-native storage/resource primitives for next-generation *authorization*

Cutting-edge **Privacy-preserving Crypto**: Zero-Knowledge, Differential Privacy, PrivacyPass, ephemeral tokens/creds, MPC, etc

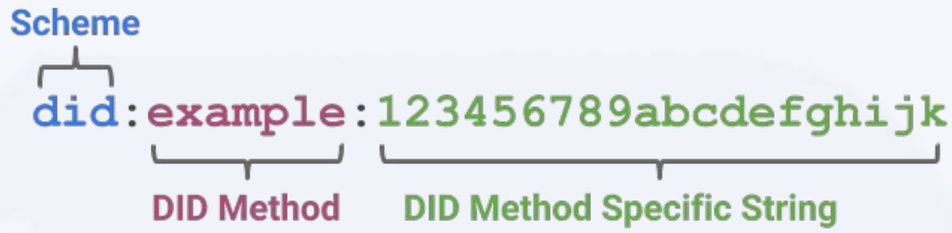
Wallets and/or Agents: Web interfaces beyond the "browser"/"app" paradigm

DEFINITION

Decentralized Identifiers

- A **Decentralized Identifier (DID)** is a new type of identifier that is *globally unique*, *resolvable* with high availability, and cryptographically *verifiable*.

- The purpose of the DID document is to describe the public keys, authentication protocols, and service endpoints necessary to bootstrap cryptographically-verifiable interactions with the identified entity.




```
{
  "@context": ["https://www.w3.org/2019/did/v1", "https://w3id.org/security/v1"],
  "id": "did:example:123456789abcdefghi",
  ...
  "publicKey": [{
    "id": "did:example:123456789abcdefghi#keys-1",
    "type": "RsaVerificationKey2018",
    "controller": "did:example:123456789abcdefghi",
    "publicKeyPem": "-----BEGIN PUBLIC KEY...END PUBLIC KEY-----\r\n"
  }, {
    "id": "did:example:123456789abcdefghi#keys-2",
    "type": "Ed25519VerificationKey2018",
    "controller": "did:example:pqrstuvwxyz0987654321",
    "publicKeyBase58": "H3C2AVvLMv6gmMNam3uVAjZpfkcJCwDwnZn6z3wXmqPV"
  }, {
    "id": "did:example:123456789abcdefghi#keys-3",
    "type": "Secp256k1VerificationKey2018",
    "controller": "did:example:123456789abcdefghi",
    "publicKeyHex": "02b97c30de767f084ce3080168ee293053ba33b235d7116a3263d29f1450936b71"
  }],
  ...
}
```

https://w3c-ccg.github.io/did-primer/

DIFFERENT STROKES FOR DIFFERENT FOLKS

>115 DID Methods Today

Method Name	Status	DLT or Network	Authors	Link
did:abt:	PROVISIONAL	ABT Network	ArcBlock	ABT DID Method
did:btcr:	PROVISIONAL	Bitcoin	Christopher Allen, Ryan Grant, Kim Hamilton Duffy	BTCR DID Method
did:stack:	PROVISIONAL	Bitcoin	Jude Nelson	Blockstack DID Method
did:erc725:	PROVISIONAL	Ethereum	Markus Sabadello, Fabian Vogelsteller, Peter Kolarov	erc725 DID Method
did:example:	PROVISIONAL	DID Specification	W3C Credentials Community Group	DID Specification
did:ipid:	PROVISIONAL	IPFS	TranSendX	IPID DID method
did:life:	PROVISIONAL	RChain	lifeID Foundation	lifeID DID Method
did:sov:	PROVISIONAL	Sovrin	Mike Lodder	Sovrin DID Method
did:uport:	DEPRECATED	Ethereum	uPort	
did:ethr:	PROVISIONAL	Ethereum	uPort	ETHR DID Method
did:v1:	PROVISIONAL	Veres One	Digital Bazaar	Veres One DID Method
did:com:	PROVISIONAL	commercio.network	Commercio Consortium	Commercio.network DID Method
did:dom:	PROVISIONAL	Ethereum	Dominode	
did:ont:	PROVISIONAL	Ontology	Ontology Foundation	Ontology DID Method
did:vvo:	PROVISIONAL	Vivvo	Vivvo Application Studios	Vivvo DID Method
did:aergo:	PROVISIONAL	Aergo	Blocko	Aergo DID Method
did:icon:	PROVISIONAL	ICON	ICONLOOP	ICON DID Method
did:iwt:	PROVISIONAL	InfoWallet	Raonsecure	InfoWallet DID Method
did:ockam:	PROVISIONAL	Ockam	Ockam	Ockam DID Method
did:ala:	PROVISIONAL	Alastria	Alastria National Blockchain Ecosystem	Alastria DID Method
did:op:	PROVISIONAL	Ocean Protocol	Ocean Protocol	Ocean Protocol DID Method
did:jlinc:	PROVISIONAL	JLINC Protocol	Victor Grey	JLINC Protocol DID Method
did:ion:	PROVISIONAL	Bitcoin	Various DIF contributors	ION DID Method
did:jolo:	PROVISIONAL	Ethereum	Jolocom	Jolocom DID Method
did:bryk:	PROVISIONAL	bryk	Marcos Allende, Sandra Murcia, Flavia Munhoso, Ruben Cessa	bryk DID Method
did:peer:	PROVISIONAL	peer	Daniel Hardman	peer DID Method
did:selfkey:	PROVISIONAL	Ethereum	SelfKey	SelfKey DID Method
did:meta:	PROVISIONAL	Metadium	Metadium Foundation	Metadium DID Method
did:tys:	PROVISIONAL	DID Specification	Chainyard	TYS DID Method
did:git:	PROVISIONAL	DID Specification	Internet Identity Workshop	Git DID Method
did:tangle:	PROVISIONAL	IOTA Tangle	BiiLabs Co., Ltd.	TangleID DID Method
did:emtrust:	PROVISIONAL	Hyperledger Fabric	Halialabs Pte Ltd.	Emtrust DID Method
did:ttm:	PROVISIONAL	TMChain	Token.TM	TM DID Method
did:wlk:	PROVISIONAL	Weelink Network	Weelink	Weelink DID Method
did:pistis:	PROVISIONAL	Ethereum	Andrea Taglia, Matteo Sinico	Pistis DID Method
did:holo:	PROVISIONAL	Holochain	Holo.Host	Holochain DID Method
did:web:	PROVISIONAL	Web	Oliver Terbu, Mike Xu, Dmitri Zagidulin, Amy Guy	Web DID Method
did:io:	PROVISIONAL	IoTeX	IoTeX Foundation	IoTeX DID Method
did:vaultie:	PROVISIONAL	Ethereum	Vaultie Inc.	Vaultie DID Method
did:moac:	PROVISIONAL	MOAC	MOAC Blockchain Tech, Inc.	MOAC DID Method
did:omn:	PROVISIONAL	OmniOne	OmniOne	OmniOne DID Method
did:work:	PROVISIONAL	Hyperledger Fabric	Workday, Inc.	Workday DID Method
did:vid:	PROVISIONAL	VP	VP Inc.	VP DID Method
did:ccp:	PROVISIONAL	Quorum	Baidu, Inc.	Cloud DID Method
did:jnctn:	PROVISIONAL	Jnctn Network	Jnctn Limited	JNCTN DID Method
did:evan:	PROVISIONAL	evan.network	evan GmbH	evan.network DID Method
did:elastos:	PROVISIONAL	Elastos ID Sidechain	Elastos Foundation	Elastos DID Method
did:kilt:	PROVISIONAL	KILT Blockchain	BOTLabs GmbH	KILT DID Method
did:elem:	PROVISIONAL	Element DID	Transmute	ELEM DID Method
did:github:	PROVISIONAL	Github	Transmute	GitHub DID Method
did:bid:	PROVISIONAL	bif	teleinfo caict	BIF DID Method
did:ptn:	PROVISIONAL	PalletOne	PalletOne	PalletOne DID Method
did:echo:	PROVISIONAL	Echo	Echo Technological Solutions LLC	Echo DID Method
did:trustbloc:	PROVISIONAL	Hyperledger Fabric	SecureKey	TrustBloc DID Method
did:san:	PROVISIONAL	SAN Cloudchain	YLZ Inc.	SAN DID Method

https://w3c-ccg.github.io/did-method-registry/

DEFINITION

Verifiable Credentials

- A **verifiable credential (VC)** is a set of *tamper-evident* claims and metadata about real life achievements, qualifications, or attributes that includes a *cryptographic proof* about who issued it.

- Examples of verifiable credentials include digital employee identification cards, digital birth certificates, and digital educational certificates, authentication and authorization bearer tokens, logistics or shipping certifications.


```
{
  "@context": [
    "https://www.w3.org/2018/credentials/v1",
    "https://www.w3.org/2018/credentials/examples/v1"
  ],
  "id": "http://example.gov/credentials/3732",
  "type": ["VerifiableCredential", "UniversityDegreeCredential"],
  "issuer": "https://example.edu",
  "issuanceDate": "2010-01-01T19:73:24Z",
  "credentialSubject": {
    "id": "did:example:ebfeb1f712ebc6f1c276e12ec21",
    "degree": {
      "type": "BachelorDegree",
      "name": "Bachelor of Science and Arts"
    }
  },
  "proof": {
    "type": "RsaSignature2018",
    "created": "2018-06-18T21:19:10Z",
    "proofPurpose": "assertionMethod",
    "verificationMethod": "https://example.com/jdoe/keys/1",
    "jws": "eyJhbGciOiJQUzI1NiIsImI2NCI6ZmFsc2UsImNyaXQiOlsiYjY0Il19
      ..DJBMvvFAIC00nSGB6Tn0XKbbF9XrsaJZREWvR2aONYTQQxnyXirtXnlewJMB
      Bn2h9hfcGZrvnC1b6PgWmukzFJ1IiH1dWgnDIS81BH-IxXnPkbuYDeySorc4
      QU9MJxdVkY5EL4HYbcIfwKj6X4LBQ2_ZHZIu1jdqLcRZqHcsDF5KKylKc1TH
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      ogZdgt1DkQxDFxxn41QWDw_mmMCjs9qxg0zcZzqEJw"
  }
}
```
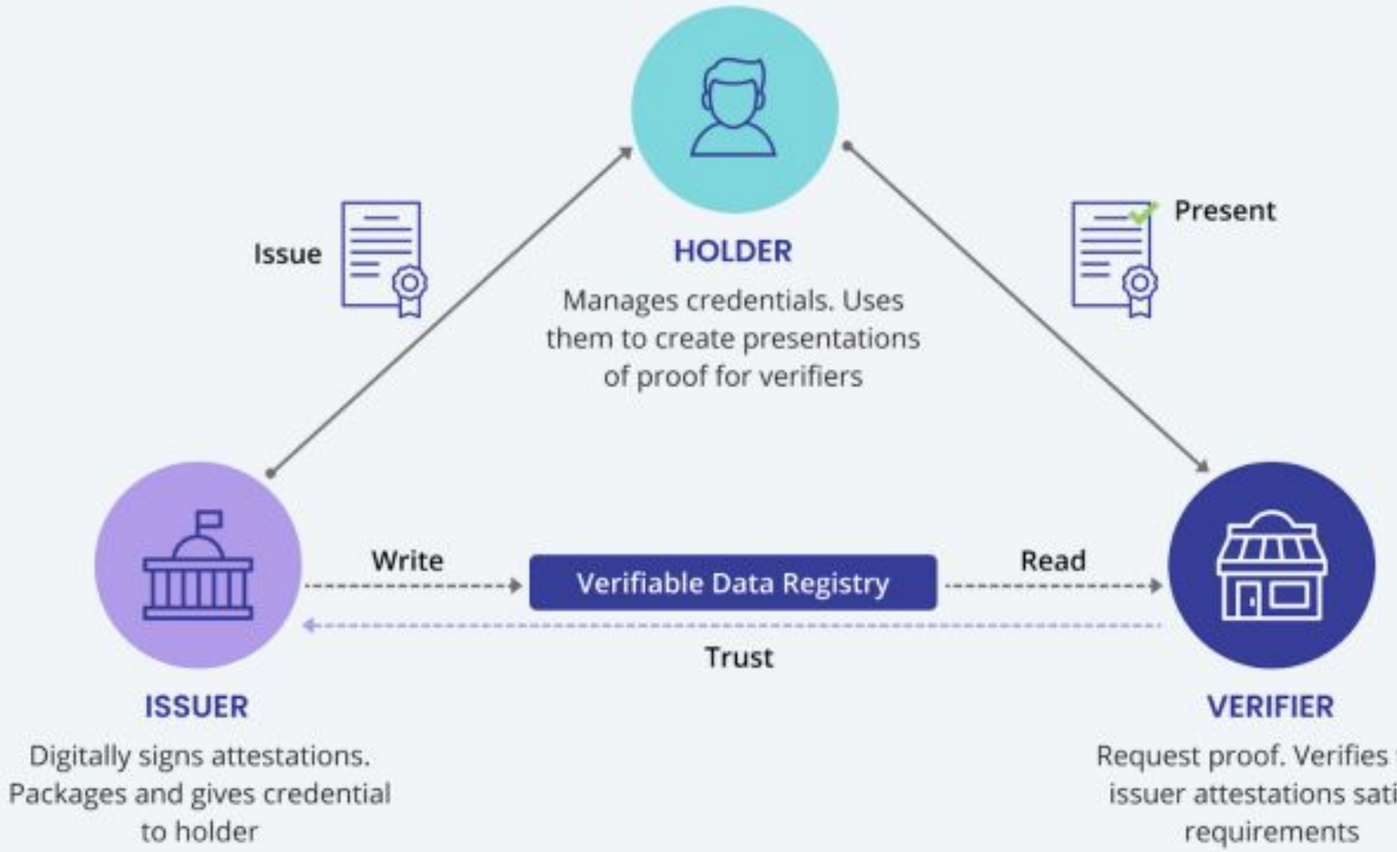


https://www.w3.org/TR/vc-data-model/#credentials

Triangle of Trust



SOURCE: AFFINIDI- WHAT IS THE TRUST TRIANGLE

DIDs + VCs Can...

- Reduce database security risks and business process risks - avoiding **toxic data**
- Give users increased to total **control** over their identity data and credentials
- Increased **data portability** and near-global scope (for reputation and history)
  - *Key use cases:* "Data takeout", social proofs, account portability
- Increase business efficiency through **streamlined onboarding & auditing**
  - Reduce fraud by confirming multiple data points
  - Streamline confirmation of compliance data/documentation
  - *Key use cases*: Non-repudiable invoices, receipts, audit trails...
- **Increase trust** of any verified data that must be shared downstream, in a form more persistent than the legal persons involved
  - *Key use cases*: Drug trials, Compliance documents, Provenance data

SLIDE INSPIRATION: HEATHER VESCENT + KIM HAMILTON DUFFY + KALIYA YOUNG

FRAMEWORK FOR ADOPTION

Is **selective disclosure** or **privacy** a priority?
Is there high **coordination** burden?
Is **traceability** or **auditability** important?

Application Areas	
Chains of Custody Commercial + Defense Supply Chain Logistics Cold Chain (pharma to agriculture) Contract Management (Legal, HR, Real Estate) Software	**Data Infrastructure & Governance** Cloud roles + access management Microservices monitoring
Telco 5G + IoT Enablement Identity/Data-as-a-Service Anti-Fraud (verification + roaming)	**Healthcare** Insurance + Billing Verifiable Clinical data and/or Device data Patient-centric data sharing + management

HOW DO WE GET THERE?

Get Involved

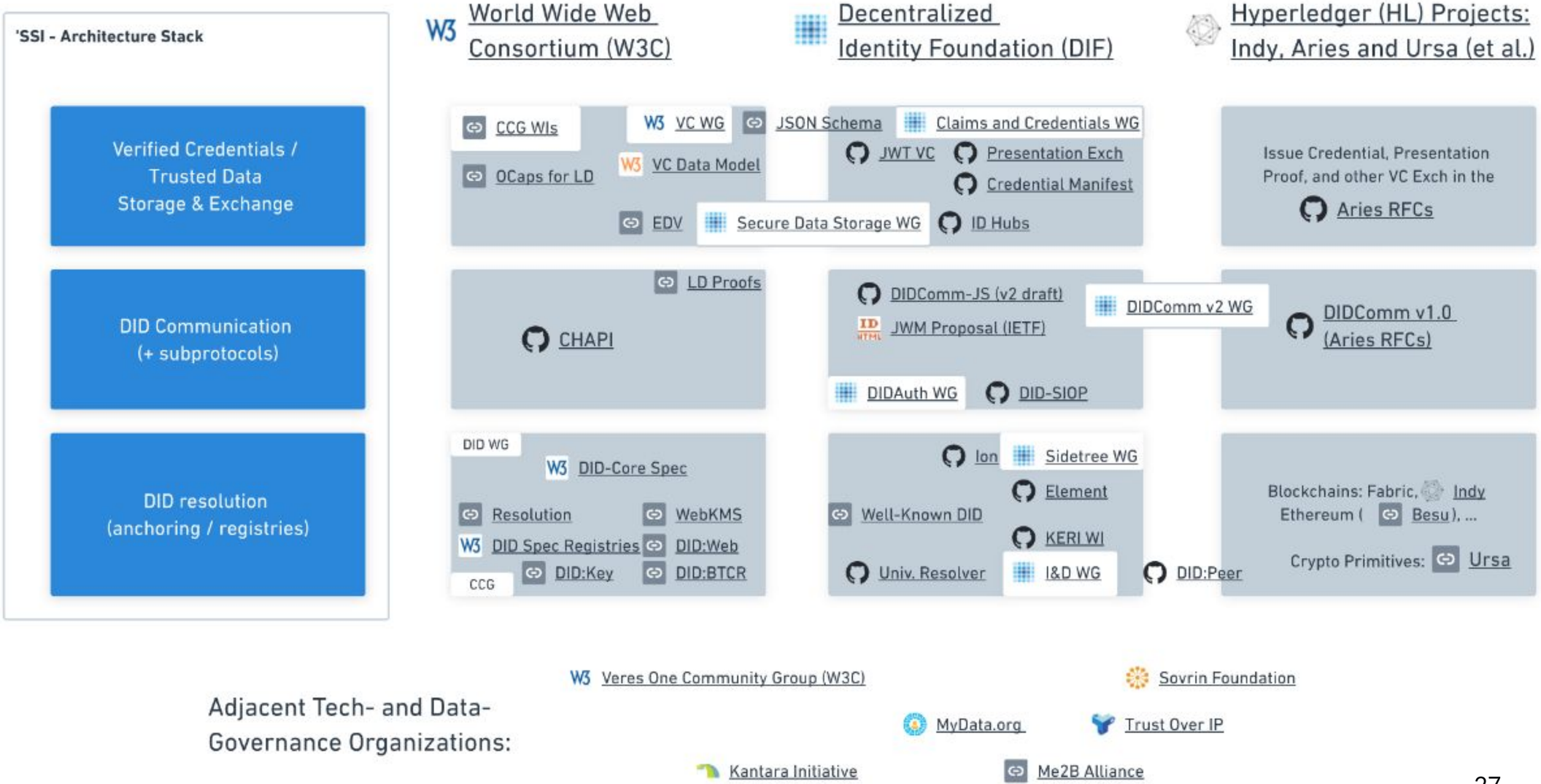
Ideation & Design	Incubation	Refinement	Standardization
Conversations	Whitepapers, position papers	Experiments, Specifications, Pilots	Standards

SLIDE CREDIT: HEATHER VESCENT @ THE PURPLE TORNADO

Get Involved

SSI Architecture Stack & Community efforts

(Rouven Heck's presentation at #IIW30, updated by DIF Dept of Ed)



Adjacent Tech- and Data-Governance Organizations:

Veres One Community Group (W3C)
Sovrin Foundation
MyData.org
Trust Over IP
Kantara Initiative
Me2B Alliance

https://github.com/decentralized-identity/decentralized-identity.github.io/blob/master/assets/ssi-architectural-stack--and--community-efforts-overview.pdf

Any questions? Any answers?

Thank You!

HOW MANY DID YOU CATCH?

Buzzword Bingo

IPR	Bitcoin	SSI
MFA	Verifiable Credentials	NFTs
Biometrics	Digital Wallet	Crypto
Internet of Things (IoT)	Passwordless	Verifiable Credentials
Open-Source	Blockchain	Interoperability
Public-Key Cryptography	Toxic Data	DIDs

Appendix 1: Introductory Materials

- DIF Decentralized Identity Knowledgebase
- Comprehensive Guide to Self Sovereign Identity (2019) - Heather Vescent / Kaliya Young
- Spherity's SSI 101 Series on Medium (2020) - Juan Caballero
- Self Sovereign Identity (2021) - Alex Preukschat / Drummond Reed
- Principles of SSI - Trust Over IP Foundation
- PSA Today: Privacy, Surveillance, Anonymity Podcast - Kaliya Young / Seth Goldstein
- Definitely Identity podcast - Tim Bouma
- One World Identity ("KNOW") Podcast
- 2019 IIW Intro to SSI Deck - Heather Vescent / Karyl Fowler / Lucas Tétreaul
- 2018 IIW Intro to SSI Deck by Drummond Reed

Appendix 2: Breadth & Depth Resources

- Infominer's reference library & curated content aggregator (with Kaliya Young)
- DID Rubric (W3C-CCG) & accompanying deep-dive podcast on DID method design
- The Purple Tornado reports for US DHS (2019)
- Webinar series - Alex Preukschat
- MyData Slack and Conference series
- CyberForge (includes some great posts by Anil John, US DHS S&T)
- Transmute TechTalk: On Enterprise Use + Integrations

Appendix 3: Tech Specifications and Working Groups

Technical Resources:

- W3C DID Specification (Aug 2021) & Use Case guidance
- W3C VC Data Model Specification
- Digital Credential Consortium whitepaper
- Credential Handler API - CHAPI
- Aries RFCs (Hyperledger)
- Work items at Decentralized Identity Foundation
    - WACI PeX, Universal Resolver, DIDcomm, ION, Presentation exchange etc.
- DIF-W3C Secure Data Storage Specification Working Group