



IDENTITY MATTERS

A primer paper on the rise and relevance of **Self-Sovereign Identity**.

Al Sherriff, CBoxx, September 2017

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Why does Identity Matter?

The rise of decentralisation ushered in by blockchain technology and the personal computing power of the smartphone has offered up a practical new way to manage Digital Identity that is appealing to nearly everyone and has enormous potential everywhere; from financial services to global supply chains to the humanitarian sector.

Self-Sovereign Identity puts each of us firmly in control of our own personal data. It can be pictured as owning a secure, digital drawer of verified identity claims that prove who we are. For example, a government issued passport, driving license, educational qualifications, work accreditations, recommendations from our communities etc.

Each one of our identity claims is digitally signed by the issuing party and the record of that verified identity claim (or ‘attestation’) is securely and permanently anchored within *our own* account on a decentralised blockchain network. Only the record of the verified claim is stored on the blockchain, not the original document or information, which remains with the issuer.

We, the individuals, hold the key to our own collection of claims. When private companies, online shops, banks, social networks, government offices, NGOs etc. want evidence of who we are before trusting us to use their services, then we only need disclose what they need to know *and nothing else*. For example, if a social network wants evidence that you are over 12 years old, then it doesn’t need your date of birth, or even your age because your self-sovereign identity can simply confirm that you are at least 13 years old, revealing nothing else. This turns our existing notions of digital identity on their head.

Nowadays we are repeatedly inputting our personal information and creating passwords for every organisation whose services we use. They in turn hold their own copy of that personal information within their own data stores and have a multitude of ways to monetise it. This is becoming increasingly risky and difficult to manage for everyone involved. The organisations must carefully manage and control their growing burden of personal data; trying to ensure that it is accurate, up to date, revocable and cannot be lost, stolen or used illegally. As individuals, our personal data and credentials are being spread around the globe putting us at increasing risk of having our identity misused or stolen from one of the many organisations we have given it too. By granting those organisations access to a single “Self-Sovereign” Identity record that we maintain and control **ourselves**, all of those risks are vastly reduced.

That’s the idea. There’s a journey already well underway to get us there ...

Humanitarian

Certain characteristics of Self-Sovereign Identity managed on a blockchain network present the humanitarian sector with particular benefits.

Blockchain networks, like the Internet they rely on, are not constrained by national borders and are resilient to disaster due to being highly distributed. A displaced person (migrant or refugee) who is carrying no proof of identity can have ways and means to rebuild or recover their identity across borders.

Here is a humanitarian scenario (simplified for this example) using blockchain concepts for both self-sovereign identity and financial supply chain transparency ...

- A migrant arrives on foreign shores, with nothing;
- They are helped by an aid worker, who hands them a mobile phone with a pre-installed Identity App and quickly helps them to take selfies and voice recordings (biometrics);
- The aid worker attests to their Identity using a QR code scan, verifying their circumstances and immediately transfers some digital aid money (tokens) to them;
- This is all they need to be granted a basic, emergency self-sovereign identity (passport) recorded on a blockchain network;
- The migrant can spend the digital money on essential goods and services (food, shelter etc) with local supporting partners or even exchange it for local currency;
- Donors to the aid workers charity can see how their funds are being used. They can track & trace exactly what is happening to their donation through a blockchain distribution network. This engages the donor and helps to make it feel real to them. Crucially this level of transparency engenders trust that their donations have not been siphoned off and misappropriated along the way. Heightened trust and transparency encourages continued donations in the future;
- The migrant now has a secure base to rebuild from and start again and if the system can then match that person from their biometrics to existing online digital records then their past Identity can potentially be discovered and recovered too. This approach can also be used to tighten security;
- The aid workers are also users of the system, this is how they are able to attest migrant's identity claims and transfer funds to them;
- The system can also be used to improve the speed of security checks on volunteers arriving to help in a fast moving disaster situation.

Humanitarian pilots have been completed or are underway testing these concepts in the real world. For example Disperse with the Start Network (*see reference #1*), AID:Tech in Lebanon (*reference #2*) and the United Nations High Commissioner for Refugees (UNHCR) are all introduced later in this paper.

Financial Services

Identity management is the core of many regulated banking processes, such as **Know Your Customer (KYC)**. In late 2016, SecureKey in Toronto obtained \$27M funding to work with a consortium of Canadian banks to implement Self-Sovereign Identity (*see reference #3*).

They are addressing the problem that regulated financial institutions must each have their own robust, KYC process. All customers must be KYC processed from scratch with each new institution they want to use. This duplication levies enormous cost, friction and inefficiency across the industry; ultimately increasing customer charges and inhibiting competition. The SecureKey goal is for each banking customer to have one record of their personal data stored on a secure industry blockchain and to be in control of how their own personal data is used.

In practical terms, this means that once a bank has verified the identity of a customer through its KYC process, that customer does not need to repeat the entire exercise again with other banks requiring KYC approval. The first bank has attested the identity of the customer; subsequent banks can agree to trust the first bank and only request additional information that is uniquely required for their own services (if any):

“Our goal for this partnership is to accelerate the pace at which we can develop a service to help consumers better manage, protect and control their digital assets and identity, and ultimately provide our customers with greater convenience and better overall experience”

Andrew Irvine, Head of Commercial Banking & Partnerships BMO Bank of Montreal

SecureKey is one example among many similar global projects in progress. **R3** is the largest of the regulated banking consortiums and is building the Corda blockchain *inspired* banking infrastructure. Ten R3 members completed a proof of concept in late 2016 (*reference #4*) ...

“The successful creation of a shared KYC service on R3's Corda platform would allow participants to create and manage their own identities including relevant documentation. They can then permission other participants to access this identity for client onboarding and KYC purposes.”

Hyperledger is the Linux Foundation managed blockchain consortium and Project Indy is their foray into exactly the same area (*reference #5*):

“The mission statement of Project Indy is restoring control to people's online identity by moving away from centralised services.”

Thirteen Projects and Startups

Blockchain based Self Sovereign Identity projects are not the sole preserve of large industry consortiums. Many fast moving startups are entering the arena, fuelled by a new blockchain based model for raising large amounts of capital with a highly engaged community, relatively easily - **Initial Coin Offerings (ICO, read reference #6 for detail on this)**.

The ICO approach to raising investment was pioneered in 2013 by Mastercoin, then Ethereum in 2015, and has accelerated rapidly from late 2016 through into 2017. It's a very new, very risky and currently entirely unregulated way of raising money that is being closely monitored by the FCA in the UK (*reference #7*), the SEC in the US (*reference #8*), while the PBoC in China (*reference #9*) are starting to put the brakes on hard while they assess. Properly run ICOs give startups the ability to rapidly level the innovation playing field with large consortia and institutions while retaining their ability to be agile by comparison. The regulators are concerned about improperly run ICOs being setup to scam unprotected investors by raising investment under false promises and then evaporating, with no consequences.

This list of 13 interesting projects / startups in the Self Sovereign Identity field should be treated as a starting point as of September 2017; it will be out of date when you read it ...

<p>#1 Civic</p> <p>www.civic.com</p>	<ul style="list-style-type: none"> • Self-Sovereign Identity startup on Bitcoin blockchain; • Intent to use Rootstock smart contract layer for Bitcoin (still in development); • Biometrics will be captured through a Mobile App; • Basic App, related services and partnerships exist now; • Orderly ICO completed in June 2017, raising \$33M.
<p>#2 Humaniq</p> <p>https://humaniq.co</p>	<ul style="list-style-type: none"> • Self-Sovereign Identity startup based on the Ethereum blockchain network and using biometrics, a mobile app and their HMQ crypto currency; • ICO completed in May 2017, raising around \$5M; • Aimed at unbanked population providing payments, transfers and local fiat currency exchange; • Launched "Lite" version of Mobile App in July 2017; • Very simple, visual user experience; • Pro version will be paid for (providing future income); • Vibrant, global community already developing well; • Collaborative - intend to provide / use APIs and incubate eco-system of 3rd party services on platform; • First pilot is now running in Ghana Q3/4 2017.

#3 BanQu www.banquapp.com	<ul style="list-style-type: none">• Self-Sovereign Identity based on a private permissioned blockchain network;• Uses biometrics (a proprietary, patent pending, selfie mashup with other characteristics) for identity and has created a Mobile App and a Web App;• Aimed at unbanked population;• Kenya pilot and also small plots farming in South America;• Won Best in Show at Finovate 2016.
#4 uPort www.uport.me	<ul style="list-style-type: none">• Self-Sovereign Identity based on the Ethereum public network;• Mobile App, Web App, Developer Libraries under development;• Alpha release available;• One of the Consensys family of companies;• Due to be used as the Identity system for Coinbase Toshi that aims to provide a universal financial services browser and apps ecosystem built on Ethereum and pitched at financial inclusion www.toshi.org
#5 Hyperledger / Sovrin / Evernym https://sovrin.org/ www.evernym.com	<ul style="list-style-type: none">• Self-Sovereign Identity that is part of the Hyperledger open source blockchain technologies cross industry project hosted by the Linux Foundation and now cited as production ready (Hyperledger Fabric 1.0);• Sovrin is a specific instance of the Hyperledger Project Indy Codebase that can be used by anyone to create a self-sovereign identity network;• Evernym is now an enterprise partner in the Sovrin eco-system;• The relationships between Hyperledger / Sovrin / Evernym are confusing!• The US State of Illinois has stated a pilot with Evernym for registering births on their blockchain with verified claims: https://cointelegraph.com/news/illinois-government-pilots-blockchain-technology-for-birth-certificate-digitization
#6 ObjectTech www.objecttechgroup.com	<ul style="list-style-type: none">• Self-Sovereign Identity network using biometrics and a blockchain network;• Working on a project to create frictionless digital passports at Dubai Airport (“biometric tunnels”);• Part of a UK fintech mission to Australia in June 2017

<p>#7 Pillar</p> <p>https://pillarproject.io</p>	<ul style="list-style-type: none"> • Bringing to fruition David Siegel’s long term vision of a “Personal Data Locker” as described in his 2010 book “Pull” i.e. Self-Sovereign Identity; • ICO in July 2017, raised approx \$21M for PLR tokens; • Highly (over?) ambitious vision to build an open-source, multi-chain wallet that will provide a new digital platform for consumers, companies, and governments. Aiming to compete at Operating System level with Google Android and Apple iOS - “The Wallet is Everything”; • Has a very large and <u>extremely</u> engaged, active, positive community, driven by an experienced and charismatic figurehead.
<p>#8 SecureKey / IBM</p> <p>http://securekey.com</p>	<ul style="list-style-type: none"> • Self-Sovereign Identity; • Mobile App and IBM Blockchain / Hyperledger Fabric permissioned blockchain infrastructure; • Working with a Canadian banking consortium and funded \$27M in late 2016 to conduct trial for KYC. Testing now and aiming to be live by end of 2017.
<p>#9 ShoCard</p> <p>https://shocard.com</p>	<ul style="list-style-type: none"> • Self-Sovereign Identity; • Mobile App and the ShoCard SDK for integration • Built on “The Public Blockchain” (this probably means Bitcoin but they are unclear about this); • Pitched at individuals and enterprises; • Has a project with SITA for airports using a “Travel Token”.
<p>#10 ID2020 / Accenture / Microsoft / Avanade</p> <p>http://id2020.org</p> <p>https://newsroom.accenture.com/news/accenture-microsoft-create-blockchain-solution-to-support-id2020.htm</p>	<ul style="list-style-type: none"> • Self-Sovereign Identity using the Microsoft Azure cloud, the Ethereum Enterprise Alliance permissioned blockchain and biometrics; • Foundation is an Accenture system that interoperates with existing Identity systems; • Identity data is stored “off chain” with the DLT acting as the anchoring point; • Announced in June 2017 at ID2020; • Prototype/demo available now; • Pitched at Identityless people as per ID2020 goals & principles.

#11 AID:Tech<https://aid.technology>

- Blockchain technology used to issue AID:Tech Digital Identity available through mobile and also offline with smart cards ('intelligent vouchers');
- Secure and traceable electronic payments;
- Successful pilot conducted in Lebanon in late 2015 with Syrian refugees;
- Aimed at the unbanked and financial inclusion;
- Type of blockchain technology used unclear from public material.

#12 IOTA<https://iota.org/><https://cointelegraph.com/news/iota-blockchain-to-help-trace-families-of-refugees-during-and-after-conflicts>

- Public, permissionless distributed ledger (i.e. blockchain inspired) technology called 'Tangle', designed from the ground up to resolve problems of scalability inherent in Bitcoin and Ethereum;
- Project for "SmartID" Self Sovereign Identity system;
- Successful ICO in December 2015;
- Recently announced partnership with REFUNITE to help reunite separated families after conflict.

#13 Cove<https://coveidentity.com/>

- Self-Sovereign Identity focussing initially on secure storage of digitized copies of your Identity documents stored on the decentralised InterPlanetary File System and backed up on iCloud or Google Drive (!?);
 - Research started in mid 2016 and has built early version Mobile App (MVP) and published on the Android and Apple App Stores;
 - Incorporated in May 2017, London based;
 - ICO commencing late September 2017 with a token called 'Shells' aiming to raise up to \$38M USD (TBC)
 - Will add verification, biometrics, value added network services etc. later, assuming a successful ICO
-

Six Interesting Initiatives and Ideas

The Self Sovereign Identity space is wide and varied. This is a list of six recent initiatives and related projects of interest to decentralised identity research. Of particular note is #2 below from **Vinay Gupta** on the role of insurance in providing protection against the consequences of successfully falsified identity claims.

<p>#1 World Identity Network (WIN)</p> <p>www.win.systems</p>	<ul style="list-style-type: none"> • Announced at the annual Blockchain Summit on Sir Richard Branson’s Necker Island in late July 2017; • Initiative to bring Self Sovereign Identity managed on blockchain network(s) to 2 billion identityless people; • Few details as yet beyond the website but it appears to want to create a global network of experts in the Identity and Blockchain fields that can lobby governments and obtain funding; • WIN will be led by Mariana Dahan. Also on the island was Vinny Lingham of Civic.
<p>#2 Hexayurt Capital</p> <p>http://hexayurt.capital/</p> <p>https://medium.com/humanizing-the-singularity/a-blockchain-solution-for-identity-51fbcae94caa</p>	<ul style="list-style-type: none"> • The investment vehicle of Vinay Gupta a serial social entrepreneur, co-founder of Ethereum and a great thinker, communicator and influencer at all levels; • Potential breakthrough idea is to back Self Sovereign Identity Claims with Insurance – the article listed on the left is well worth a read or listen and is the foundation idea for ... • “... <i>we should be able to build an identity system that actually works in the Netherlands in about a year.</i>” • Also see http://internetofagreements.com/ (IOA) • The inaugural IOA conference will be in October 2017 in London

<p>#3 United Nations High Commissioner for Refugees (UNHCR) / Accenture</p> <p>https://www.accenture.com/gb-en/success-unhcr-innovative-identity-management-system</p>	<ul style="list-style-type: none"> • An Identity project initiated in 2013 that uses biometrics <i>that “rapidly registers, de-duplicates and verifies the identities of refugees, ensuring that the right people receive assistance where and when they need it”</i>; • This may well be providing the foundational biometrics technology for the ID2020 project with Microsoft and Avanade; • Real world pilots in Thailand and Chad reportedly delivered impressive results.
<p>#4 United Nations World Food Programme</p> <p>https://www.wfp.org/news/news-release/blockchain-against-hunger-harnessing-technology-support-syrian-refugees</p>	<ul style="list-style-type: none"> • Builds on the UNHCR projects, coupling the biometric registration from that, now coupled with blockchain technology; • Refugees purchase food from local supermarkets in the camp by using a scan of their eye instead of cash, vouchers or e-cards; • It looks like blockchain is being used for managing the transactions without the need for intermediaries.
<p>#5 GOV.UK Verify</p> <p>https://www.gov.uk/government/publications/introducing-govuk-verify/introducing-govuk-verify</p>	<ul style="list-style-type: none"> • Single login to all UK Government services. • Decentralised (federated, <u>not</u> self-sovereign) Identity; • Certified Identity Providers verify your identity for the UK government. e.g. Barclays, Experian, Post Office, Royal Mail ... • Now used by HRMC, DWP, DVLA government services; • Will also be used by the UK Pensions Dashboard; • Interesting to look at for comparison against the ideals of self-sovereign identity.
<p>#6 Aadhaar Biometric Identity in India</p> <p>https://uidai.gov.in/</p> <p>https://en.wikipedia.org/wiki/Aadhaar</p>	<ul style="list-style-type: none"> • Massive government backed initiative to assign a biometrically generated (from fingerprint and iris scan) unique national identity for life to every citizen of India; • Has registered 90% or over 1 billion citizens now; • Deep concerns and controversy over privacy and data security concerns. This is <u>not</u> Self Sovereign – it is state run and becoming mandatory – initially for controlling benefit fraud but advancing into other areas; • http://www.bbc.co.uk/news/world-asia-40371523

Where are the Standards?

The explosion of blockchain startups powered by substantial funding raised through Initial Coin Offerings has been driven by the introduction of a simple standard called **ERC20** for Ethereum tokens (*reference #10*):

The ERC20 Token Standard Interface

Following is an interface contract declaring the required functions and events to meet the ERC20 standard:

```

1 // https://github.com/ethereum/EIPs/issues/20
2 contract ERC20 {
3     function totalSupply() constant returns (uint totalSupply);
4     function balanceOf(address _owner) constant returns (uint balance);
5     function transfer(address _to, uint _value) returns (bool success);
6     function transferFrom(address _from, address _to, uint _value) returns (bool
success);
7     function approve(address _spender, uint _value) returns (bool success);
8     function allowance(address _owner, address _spender) constant returns (uint
remaining);
9     event Transfer(address indexed _from, address indexed _to, uint _value);
10    event Approval(address indexed _owner, address indexed _spender, uint _value);
11 }

```

Widespread adoption of this standard has accelerated an entire ICO ecosystem of blockchain startups, exchanges, wallets, and research sites that anyone can play in if they support the ERC20 token standard on Ethereum.

Identity Management also has a set of standard characteristics, for example “A Framework for Identity” IDEO CoLab (*reference #11*) neatly categorises them:

Issue	A way of creating new identities and assigning identifiers
Store	The storage of identity data
Authenticate	How an individual proves who they are when attempting to assert their identity e.g. a combination of one or more of: something you know (password), something you have (mobile, card), something you are (biometric)
Authorize	Having passed authentication, individuals are granted permission (authority) perform certain tasks presented by the service they have accessed
Recover	The means for individuals to regain access to their identity data if they lose it
Update	The ability to edit attributes of identity
Verify	The means to check/audit that identity data is accurate

These characteristics apply to any type of identity system, and must therefore be addressed by Self-Sovereign Identity systems. Though clearly this is far more of a challenge than standards for Ethereum cryptocurrency tokens, the same principles apply.

The scenario presented earlier in this paper with an aid worker assisting a migrant is vastly simplified. Now imagine a long queue of migrants waiting to be processed for assistance. Some will have mobile phones and some will not. Some will already have digital identities and some will not. Each aid worker has a digital identity but different charities may use different systems.

As highlighted there are many self-sovereign identity players emerging and the aid workers and migrants could potentially be using many different systems. The adoption of open standards by these systems means that they can interoperate with each other and the queue can be processed without a problem because it won't matter if each person is using a different identity system.

Open Standards generate healthy competition and innovation, preventing any one player from gaining a monopoly because users can freely move between systems. The potential for monopolisation of digital identity feels very wrong!

There are several Self-Sovereign related standards related initiatives in progress but nothing mature and established as yet ...

World Wide Web Consortium (W3C) Verifiable Claims Working Group

<https://w3c.github.io/webpayments-ig/VCTF/charter/charter-motivation.html>

Mission

“It is currently difficult to transmit banking account information, proof of age, education qualifications, healthcare data, and other sorts of verified personal information via the Web. These sorts of data are often referred to as verifiable claims. The mission of the Verifiable Claims Working Group is to make expressing, exchanging, and verifying claims easier and more secure on the Web.”

Problem Statement

“There is currently no self-sovereign and privacy-enhancing standard for expressing verifiable claims (aka: credentials, attestations) via the Web.”

And ...

*“In existing attribute exchange architectures (like SAML, OpenID Connect, Login with SuperProviderX, etc.) users, and their verifiable claims, do not independently exist from service providers. **This leads to vendor lock-in, fragmentation of identity across different services, reduced competition in the marketplace, and reduced privacy for all stakeholders.** There is no interoperable standard capable of expressing and transmitting verifiable claims that works the same across industries (e.g., finance, retail, education, and healthcare). This leads to fragmented industry-specific solutions that are costly and inefficient.”*

Is the proposal mature enough for standardization?

*“**Yes.** The work on this proposal has been incubated in multiple W3C Community Groups for several years and has benefited from wide review during that time period. There are commercial pilot projects underway that utilize the technology.”*

And ...

“A recent survey of 56 organizations from diverse industries show strong support for the problem statement, goals, scope of work, and use cases.”

International Organisation for Standardization (ISO) ISO/TC307 Blockchain and distributed ledger technologies

<https://www.iso.org/committee/6266604.html>

Progress

So far, one ISO meeting has been held, in April 2017, in Australia where the following Study Groups were agreed ...

- ISO/TC 307/SG 1 Reference architecture, taxonomy and ontology
- ISO/TC 307/SG 2 Use case
- ISO/TC 307/SG 3 Security and privacy
- **ISO/TC 307/SG 4 Identity**
- ISO/TC 307/SG 5 Smart contracts

The next meeting will be in November 2017, in Tokyo where the technical committee will evaluate the progress of the five study groups. An article from Morten Helles, one of the attendees of the first meeting (*reference #12*) mentions that, “*Regarding timeline, ISO doesn’t hurry. Realistically, we might have an official standard on Terminology, which is most important right now, by end of next year.*”

The Decentralised Identity Foundation (DIF)

<https://decentralized-identity.github.io/>

Progress

The Decentralised Identity Foundation was publicly announced at the Consensus 2017 conference in May 2017 in New York.

The membership of DIF includes: Microsoft, IDEO, R3, **Civic**, **Sovrin**, **uPort**, RSA and more.

The working groups listed are:

- Identifiers, Names and Discovery
- Storage & Compute
- Attestations & Reputation
- Use Cases & Requirements

Again, it's very early days but encouragingly the DIF membership does include some of the prominent startups who are building their company around Self Sovereign Identity and will have an interest in driving the process forwards at pace.

What Next?

Right now our digital identities are fragmented, scattered across the digital realm and becoming ever more beyond our own control. This is an increasing risk both to individuals and to the organisations holding that personal data.

Tightening European regulation such as GDPR is forcibly directing a move to bring control back to individuals. The rise of decentralised connectivity, data storage and computer processing power characterised by coupling blockchain technology with smartphones provides a perfect technical vehicle to make this happen through Self-Sovereign Identity.

When a new digital market emerges, the need for standards follows. Open Standards help to fuel and grow markets because they reduce the barriers to entry by giving new entrants a well-defined starting point and a means to compete on a level technical playing field. Meanwhile, ICOs are levelling the financial playing field too, this could make identity incumbents such as social media network giants nervous and likely to react.

The proliferation of companies, projects and groups now emerging around Self Sovereign Identity makes the creation of open standards look inevitable so that systems can interoperate with potentially many different digital identity systems; of both Self-Sovereign and 'traditional' design.

The brief research in this paper points towards the **W3C Verifiable Claims** and **Decentralised Identity Foundation** initiatives being the most promising at this stage and emerging players would be well advised to research further and participate at some level in these groups. Successful standards implementations are usually driven by a small group of pioneering collaborators who want to move out of the talking shops and make it happen. The rest must then follow.

Finally, I urge you to read **Vinay Gupta's** piece "A Blockchain Solution for Identity?" that proposes the use of insurance to make Self-Sovereign Identity work in the real world. The combination of this idea with standards and decentralised technology may be an answer ...

The identity ownership thing. *The individual facts are owned by other entities; the assemblage of those facts and the rendering of that information to something that could be used is owned by me, and this bridges nicely this problem of half of the stuff is owned by one person and half of it is owned by another. "You know my driving record, I am the person that was doing the driving. We package that up into an insurance product, I pay for it and we sell it." Very, very simple.*

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Over 20 years of experience working in UK financial services technology as a developer, business analyst, technical architect and agile project manager. Notable clients include Standard Life, Time4Advice implementations at St. James's Place and Mattioli Woods, Profile Pensions, AXA Wealth, Association of Professional Financial Advisers, Chase de Vere, Skipton FS and Origo Standards & Services.

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