DEVELOPMENT OF THE APPLICABILITY OF BLOCKCHAIN TECHNOLOGY IN INDUSTRY AND SERVICES

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Abstract: Every day, the number of blockchains used in real world scenarios grows. From logistics to fine art, it's hard to find a sector that hasn't been touched by this transformative technology. We have reached a point where the technology has proven itself to be superior than the current modus operandi. The goal of this paper is a review of most recent important blockchain technology applications in fulfilling the right of everyone to recognition everywhere as a person before the law by introducing the concept of self-sovereign identity, and, how blockchain technology can manage the future electricity grid.

Keywords: blockchain, applicability, self-sovereign identity, electricity grid.

1. Introduction

A blockchain is a database, an organized collection of data, that can be shared between a group of non-trusting individuals, without needing a central party to maintain the state of the database. It is also often referred to by the name 'Distributed Ledger Technology', DLT for short.

According to Vitalik Buterin (Buterin) – creator of the decentralized platform that runs smart contracts – "…blockchain has the ability to enhance reliability in business processes by eliminating political and economic risks associated with trusting a centralized system." On the other hand, in the opinion of M.G. Zago (Zago) – founder of Essentia.one (essentia.one) and chairman of The Internet of Blockchains Foundation – …"when talking about blockchains, we commonly think of its applications in the future. 'Blockchain will solve this, blockchain will achieve that'. It's easy to forget that blockchains are already deployed in the wild. Pick an industry, from automobiles to artificial intelligence, and odds are you'll find examples of blockchains in action. In all quarters and all circles, blockchains are making their mark. Even the US Treasury is in on the act, advocating for more pilot projects and test programs. The 'World Economic Forum' anticipates that 10% of global GDP will be stored on the blockchain by 2025. That means the global executives out there are preparing for this seismic

shift, and are ready to completely back its implementation. The impact of distributed ledger technology could be as grand as the internet revolution itself. The use cases differ, but the benefits derived from using the technology remain unchanged: transparency, immutability, redundancy and security. In 2018, new blockchain initiatives are launched every day…."

Main properties of a Blockchain (Konstantopoulos) Transparency: Every transaction can be inspected by anyone (keyword: block explorer). Decentralization: Every node (a peer in a peer-to-peer distributed system of computing resources that together form a blockchain system, each of which runs a client) which maintains the network has a copy of the ledger. That creates redundancy and fault tolerance (i.e if a node fails or stops working, the rest of the nodes can keep maintaining the network without interruption). Decentralization along with proper mechanisms to ensure that no faulty transactions get included in the ledger give birth to data integrity, the so-called immutability of the blockchain. When a piece of information gets recorded, it is set in stone and cannot be rewritten. Every single property of a blockchain on its own might not sound like too remarkable, however when combined together, new properties appear which in turn create the possibility for new revolutionary use cases. The goal of this paper is a review of recent most important blockchain technology applications by introducing the concept of self-sovereign identity, and - how blockchain technology can manage the future electricity grid.

2. Self-sovereign identity

Self-sovereign identity (Lewis) is the concept that people and businesses can store their own identity data on their own devices, and provide it efficiently to those who need to validate it, without relying on a central repository of identity data. It's a digital way of doing what we do today with bits of paper. This has benefits compared with both current manual processes and central repositories.

If e-mail proved to be the "killer app" for the Internet, identity solutions will prove to be the "killer app" for blockchain. Identity systems, as we know them today, are highly dysfunctional, operating in silos, and insecure. Blockchain-based identity systems will solve these problems. These systems will provide a single source of verification for individuals' identities and assets.

Blockchain-based identity decentralizes the data collection, cross-verifies the collected data via a consensus mechanism, and stores this information on a decentralized immutable ledger. It enables reduced risk of security breaches, significantly higher efficiencies, higher reliability, and most importantly self-sovereignty (Szewczyk, 2017, p. 111-128).

2.1. First Publicly Verified Blockchain Identity

Zug in Switzerland, known as "Crypto Valley", has developed a blockchain project in partnership with Uport (Uport) to register residents' IDs, enabling them to participate in online voting and prove their residency (Kohlhaas). Swiss City of Zug and local development partner (ti&m) are introducing the world's first live implementation of a self-sovereign government issued identity on Ethereum (Spencer). Thus far, more than 50 citizens in Zug have successfully verified their uPort identity in person with the City, enabling them to access a new suite of e-government services in a trusted and self-reliant manner. In his announcement P. Kohlhaas outlined the underlying mechanics of the Zug identity verification system, the benefits this provides for various stakeholders, as well as future use cases and its evolution as follows below. Overview of the Zug City Identity user flow: 1. Citizen downloads uPort app from Apple App Store and creates an account. 2. The uPort app creates a unique private key on citizen's phone and deploys two smart contracts on the Ethereum network that act as the user's identity hub. 3. More specifically, citizen's private key manages a controller contract, which allows her to recover access to her identity should she lose access to her phone. The controller contract in turn controls her identity (proxy) contract, or permanent identifier. With this setup, citizen is now in complete control of her identity and all its associated data and can't lose access due to loss of her private key. 4. After around 2 minutes, citizen has created her uPort ID on the public Ethereum network and may now visit the website of the City of Zug at https://stadtzugid.zg.ch/ to register. Here, she scans a QR code to interact with the identity of the City for the first time. The City has its own identity on a public Ethereum network that allows it to sign and verify data. 5. Access to the Zug City identity is managed by the City clerk, who uses their own personal uPort identity authorized with specific administration rights. 6. Once citizen has entered her date of birth and passport number on the City website, her request is cryptographically signed and sent to the City as a new verification request. 7. She is asked to visit the City's citizen registration office for an in-person verification of her details within 14 days. 8. Once confirmed, the City clerk issues the citizen a verified attestation that is signed by the City's identity, as a server-side credential. 9. The Zug ID attestation data is not stored on the blockchain, but stored on her device in an off-chain environment. Instead of being publicly accessible or stored with a central service provider, the citizen chooses who she wants to selectively disclose that information to – be it the City, a service provider, or another dapp (decentralized application) . In addition, her passport number, date of birth or other sensitive information is never revealed to others scanning the blockchain. The citizen is now able to interact with the online services of the City of Zug in a seamless way. She doesn't need a user account or password to log-in, and with each interaction she does, the City knows exactly who it's dealing with. Whenever she logs into the City's web portal, a "Requester server" validates that the identity who provides the attestation is the same identity that received the previous attestation.

2.2. Benefits of the uPort ID solution

Low infrastructure requirements - as the City is relying on a public instance of Ethereum, it does not need to host its own servers or nodes, or maintain complex databases of user credentials. Furthermore, it doesn't need to invest in building a knowledge base for users to interact with the Ethereum blockchain thanks to the uPort fueling server. Decreased security risk – as the City does not host its own servers but instead distributes the ownership of both identity and attestation to its Citizens, it is less susceptible to cyber attacks or data theft. GDPR (General Data…) compliant – the City and anyone who wants to use this attestation is fully GDPR compliant. Companies merely verify the minimum amount of information necessary for a specific use case. This reduces liability for service providers, as they only save the data that they use. Cost effective – In comparison to other identity services, the uPort implementation is currently free as it relies on a public testnet Rinkeby (What is…). Once it moves to the public network the Gas (Madeira) costs would be anywhere between $1-$10. Scalable – the attestations in this use case are being issued off chain and disclosed selectively. This means there are no transaction costs for on chain transactions, or backlogs with the City.

3. Electricity grid (Miller)

One of the biggest challenges facing the energy industry, companies in the habit of trading surplus supply need infallible record keeping. Tracking energy allocations in real time, and ensuring efficient distribution through the supply chain requires multiple data points, and also mandates close cooperation between all entities. The grid is fast changing from the old system of analog, fossil-fuelled, centralized generation and transmission to a new paradigm defined by a high percentage of renewables, especially solar and wind, and customer-sited smart technologies, such as rooftop solar, battery energy storage, electric vehicles, smart thermostats and more. A more distributed and decarbonized energy future requires a more decentralized solution, in order to make the leap from the legacy grid of yesterday to the most fully realized grid of tomorrow. That's where blockchain becomes central to the story (Miller). In the opinion of D. Miller (Miller), transparency is crucial in renewable energy markets because buying green energy – both the kilowatt-hours themselves and the clean attributes associated with them – Is different than buying other products. Buyers cannot control or observe the electrons from the electric grid that actually power their facilities. Those that want to power their facilities with renewables therefore depend on an accounting tool known as certificates of origin, which include renewable energy certificates (RECs) in the United States, guarantees of origin (GOs) in the European Union, and International REC (I-REC) in emerging markets. Such certificates are the proof of green purchases, thus creating a bridge from blind faith to trusted, auditable

verification. Certificates of origin provide standard details about each megawatt-hour (MWh) of renewable energy generation, including how (wind, solar, etc.), where, when, and by whom the MWh originated. Inherent in these details is the ownership of the "green attributes" for each MWh, which can be transferred, bought, sold, or held and retired. Blockchain technology – combined with thoughtful technical design and internet broadbase industry and regulatory engagement – offers a remarkable opportunity to upgrade the way renewable energy and carbon markets work. A more transparent and user-friendly solution will help catalyze investments worldwide. Luckily, given the need for immediate global climate action, new blockchain-based applications are in rapid development right now, as major tech releases and announcements at Event Horizon in Berlin, Germany, April 17-19, 2018, were issued by Energy Web Foundation (EWF) (Bronski, Creyts, et al.) – a global nonprofit organization (Hartnett, and Bronski). The incorporated in Zug, Switzerland, Energy Web Foundation (EWF) is a global nonprofit platform unleashing blockchain's potential to accelerate the transition to a decentralized, democratized, decarbonized, and resilient energy system . EWF is building the shared, digital infrastructure – an open-source, scalable blockchain platform – specifically designed for the energy sector's regulatory, operational, and market needs. EWF is poised to become the industry's leading choice as the foundational base layer, providing the building blocks powering the world's energy future (Hartnett, and Bronski). At the Energy Web Foundation (EWF), in collaboration with more than 50 affiliates from around the globe, they are developing an open-source, scalable blockchain platform tailored for the energy sector (energyweb.org/blockchain). At the mentioned above Event Horizon in Berlin P. Bronski and O. Pujoldevall (Bronski, and Pujoldevall) informed that the Energy Web chain is designed to handle the transaction throughput required from the fast emerging decentralized, internet-connected electrical grid. It serves as a foundational, shared, digital infrastructure for the energy and blockchain community to build and run their solutions. Together, the Energy Web Foundation, Affiliates, and Community are unleashing blockchain's potential to accelerate the transition to a decentralized, democratized, decarbonized, and resilient energy system. They announced that the Decentralized Autonomous Area Agent (D3A) (Hartnett, et al., 2017) is being build, which gets even more directly to the heart of how to manage and operate a heavily decentralized grid. EWF is developing the D3A via two distinct workstreams: 1. A cloud-based simulation environment for configuring and testing transactive markets in specific grid topologies that will be available to the public for testing in Summer 2018. 2. EWF plans to deploy the open-source D3A market model on the EW Blockchain in partnership with organizations across the blockchain and energy ecosystem. The D3A is a transactive energy market design platform operating on top of the Energy Web chain. It offers a framework that pushes the bounds of what is possible, running the electricity market in an entirely different way. The D3A balances the grid from the edge up, not the top down. At every scale of the grid – from individual devices, to buildings, neighbourhoods, and regions – the D3A nests hierarchical markets, coded as blockchain smart contracts, which govern the transactions that balance electricity supply and demand. In this

way, the D3A functions like pieces of digital DNA, providing the foundational blueprint for each "cell" of the system without centralized dispatch (Bronski, Creyts, et al.). Drawing on decades of research and experience from academic, business, and governmental institutions, the team of authors of the D3A market model believed that three principles should inform design decisions for a new grid paradigm: decentralization, recursion and private transparency (Bronski, Creyts, et al.). Later in 2018, EWF will publish a technical white paper describing the features and functionality of the EW Blockchain in detail, as well as a full report articulating the issues facing today's grid, detailed theory for design principles, and how D3A can add value in any setting. Following additional modeling and testing, EWF will also publish subsequent papers quantifying the results of the D3A market model on actual distribution grids (Bronski, Creyts, et al.). While these are all promising developments, much remains to be done before the D3A, or blockchain more generally, achieves any kind of true commercial scale in the energy sector.

4. Conclusions

Every day, the number of blockchains used in real world scenarios grows. From logistics to fine art, it's hard to find a sector that hasn't been touched by this transformative technology. We have reached a point where the technology has proven itself to be superior than the current modus operandi.

Blockchain Identity for All (Mitselmakher) – if e-mail proved to be the "killer app" for the Internet, identity solutions will prove to be the "killer app" for blockchain. Identity systems, as we know them today, are highly dysfunctional, operating in silos, and insecure. Blockchain-based identity systems will solve these problems. These systems will provide a single source of verification for individuals' identities and assets. The decision to disclose identity information will be within each individual's control.

The energy web blockchain (Bronski, and Pujoldevall) – the Energy Web is an open-source, scalable blockchain platform specifically designed for the energy sector's regulatory, operational, and market needs. It serves as a foundational, shared, digital infrastructure for the energy and blockchain community to build and run their solutions. Together, the Energy Web Foundation, Affiliates, and Community are unleashing blockchain's potential to accelerate the transition to a decentralized, democratized, decarbonized, and resilient energy system. Blockchain and blockchain-related technologies are being rapidly invented to the point that it is difficult to define specifically which properties are necessary to constitute a blockchain.

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