“Can blockchain save IoT?”

The Chain of Things Case Study Project(s) will document practical, real world implementations of secure blockchain based IoT stacks with specific emphasis on key security layers. Through multiple case studies conducted in collaboration with partners, Chain of Things will build a clearer picture of what the most optimal IoT+blockchain stack should include and will determine if blockchain technology is a legitimate improvement over legacy security solutions. This emerging framework will be an invaluable model for future deployments of secure and stable IoT+blockchain applications.

Summary

Today there are more connected devices than human beings. We are outnumbered. By 2020, it is estimated that there will be between 50 and 200 billion connected devices (Source: Intel & Cisco) all collecting, relaying and actuating on data. Cybersecurity is the biggest priority in an ever-connected world. We have seen numerous hacks with disastrous consequences for business and even governments. We need a common standard to give machines and sensors the ability to communicate and collect data trustlessly with full transparency, accountability, and responsibility.

When you look at the state of Internet of Things (IoT) today, it doesn’t take a genius to see that there is a security blackhole. No one checks their terms of business when they buy a connected device. If they did, then they would learn that the company disclaims all liability for everything. This is not good enough.

Blockchain is the most secure database technology in the world. The bitcoin blockchain is an online monetary system; if you put money on the internet then surely more than anything else it will be hacked. But bitcoin blockchain is still there and standing strong.

So can these security properties within blockchain technology serve and secure IoT?

Our first investigation is a practical case study connecting devices to different blockchain protocols and seeing whether that approach is more secure that the way things are done in IoT today.

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Background

IoT

Dubbed the 4th industrial revolution, the ‘Internet of Things’ will consist of a vast network of sensor nodes that will generate an unprecedented flow of global data. These devices will quietly execute smart contracts with physical actuators that will manage many aspects of our future lives. These sensors and connected devices will indeed make the planet more efficient, but as their ‘sensing’ characteristics begin to imitate those of natural organisms, they must be respected and treated as such.

Blockchain

Blockchain technology has effectively protected billions of dollars of digital value without a single hack. Can a clever integration of this technology solve the existential security threat posed to IoT? Who knows? Thus far, there is growing interest in the space, with industry leaders such as IBM & Samsung as some of the first to explore potential solutions. Chain of Things is the first-of-its kind Think Tank and Industry Consortium to answer this critical question: can Blockchain essentially save IoT? Yes or no? If yes, we will support collaborative development on an open source standard to secure IoT devices.

Security

With an estimated 50-200 billion connected devices by 2020, this developing industry is still lacking a basic standardized security solution. What public infrastructure hack or medical record data leak will it take for us to fully acknowledge the risk? It is our responsibility and legal imperative to explore the development of a future resistant open protocol to protect business, government and consumer data. It is negligent to grow this industry without serious consideration of the primary risk.

Case Study One: ElectriCChain Solar Project

ElectriCChain Solar Project

The ElectriCChain is an open science project dedicated to the intersection of solar energy, IoT and blockchain technology. One of the ElectriCChain’s goals is to connect the world’s 7 million solar facilities, watching the skies 24/7 and posting live data to one blockchain for scientists, researchers and human progress. Initial focus is on verifying and publishing solar power generation data publically in near real time. The ElectriCChain project supports the development of open standards and tools to publish and read solar electricity generation data using the SolarCoin blockchain and/or other blockchain technologies.

Project Owners

- Francois Sonnet - f.sonnet@solarchange.co
Goals

- Specifications for scientific & network data
- Tools for publishing & ingesting solar energy data to and from the Blockchain
- Discover ElectriCChain vendors (inverters/panels/monitoring technology) etc.
- Define irradiance, energy and reporting data standards to shape an open world
- Information from the initial solarcoin blockchain with data from 21 participating countries

Supporting layers

- **Bitsseed**
  - Jay Feldis - jay@bitseed.org
  - Mike Doty - mike@bitseed.org
- **IOTA**
  - David Sønstebø - davidsoenst@gmail.com
  - Dominik Schiener - dom@schiener.me

Security Objectives

Key IoT Stack Security Weak Points

1. Data origin authenticity
   a. Data stored on a blockchain is only as good as the sensor that it originates from. It is essential to secure the authenticity of the data’s point of origin with as much detail as possible. Initial concepts for this involve strong device identity characteristics to prevent against fraudulent data due to malware or device tampering. This can be accomplished by monitoring sensor firmware authenticity and multi element sensor environmental data authenticity.

2. Securely sending data from logger to ledgers
   a. The depositing of sensor data on a distributed ledger will occur in a similar fashion to that in which a traditional crypto currency transaction record takes place. In this case, however, it is important that the data origin authenticity is first confirmed so that unqualified data does not pollute the ledger.

3. Maintaining data securely on ledger
   a. Securing data on a ledger can be accomplished by distributing a record of events across a broad distributed network of supporting nodes. Like all blockchain applications, the decentralized and distributed nature of the platform allows for no single point of failure that might be culpable to a hack. This also means that any retroactive modification of ledger data is nearly impossible as the attacker would need to circumvent the security properties of the blockchain. There are known attacks such as the 51% in the Proof of Work consensus model, but there known ways to address this.

4. Sharing/transacting data thereafter securely
   a. With the use of private and public keys, sensor owners will be able to clearly define permission levels for access to their sensor data. Eventually this will translate into a broader platform in which...
sensor owners can provide chosen levels of sensor data transparency that can be accessed by individuals or other devices.

Solar Case Study

**General IoT Stack Layers**

1. Data Input (the sun)
2. Solar Cells
3. Data Logger
4. Distributed Ledger
5. Device Owner Access
6. Third Party Access
Case Study Goals

1. Discovery
2. Research
3. Improvements
4. Energy Market

ElectriCChain Technical Project Layers

1. Cross Blockchain Scripting Language
   a. Scope: To build out a proof of concept so blockchains can communicate with one another at multiple block counts or any point in time back to the genesis block for synchronization purposes.
   b. Goals: We have the first use case, connect the Ethereum Blockchain and the Grid-Singularity Project to the SolarCoin Blockchain so that the ElectriCChain can be identified with both projects. Add nodes to the GSy project and grow the ElectriCChain node count simultaneously. Adding a language interpreter in the SolarCoin wallet and maybe embedding the Ethereum code within the Electrichain database. This maintains autonomy and adds functionality.
   c. Dream: You can configure the relevant blockchain to talk to any blockchain at any point in time. This can help large datasets aggregation for data miners and analytics firms with their own APIs and Dapps.

2. ARMv7/Bitseed Stalking Node
   a. Scope: Connect the hosting Bitseed node to the SolarCoin blockchain.
   b. Goals: We need more SolarCoin nodes globally that are easy to setup. This problem is solved with Bitseed.
   c. Dream: As many of these nodes as possible, Low cost and super easy to buy with SolarCoin, install and stake SolarCoins. Generate solar value.

3. ElectriCChain Industrial Scale Data Logger Node
   a. Scope: Industrial Scale DC datalogger. This logger called the WCC200 is made by Cloud Industries. It has its own login platform, it needs to be converted so that SolarCoin can be added in the format 1MWh = 1SLR.
   b. Goals: Decentralized where small remote solar powered communities are self-funded by the sun. They can then generate supplemental income in SolarCoin and trade this for other goods and services. Smart contracts for insurance, micro-financing and micro-banking. Dapps could also be built for these currently estimated 1 billion people.
   c. Dream: Producing a Standardised “plug-and-play” “one size fits all” Datalogger communicating with any inverter brand, connected to the ElectriCChain.

4. IOTA Solar-Tangle Pilot
   a. Scope: To get a simple data logger to connect to the IOTA chain to integrate the data delivered from an IOTA-SLO (Solcrypto) proprietary smartgrid iot-datalogger (ie, able to read the solar production from any inverter, regardless of the brand) directly to a Tangle, and to duplicate this data on the SLR Blockchain for the purpose of granting SLR's. Communicate with the SolarCoin Granting Engine API on AWS. Send encrypted information to user profiles at Solcrypto (and other affiliates) user logins. All done securely.
   b. Goals: Connecting an IOT-Datalogger/ output of an Inverter directly to the Tangle, then sending the relevant information to the SolarCoin blockchain so that the SolarCoin Granting API can grant SolarCoin’s securely. Additionally building the first secure nodes on the ElectriCChain.
   c. Dream: Federal and industrial partners link into the ElectriCChain, facilitating widespread adoption across multiple sectors and industries. 7 million global solar energy facilities linked into the largest solar energy and earth monitoring tool creating multiple commercial, scientific and research applications.
Deployment Goals

1. Help Save Tokelau
   a. Tokelau is the world’s smallest economy estimated at $1.5m GDP spread across 1,411 residents in the south pacific. $100,000 of GDP or roughly 7.5% comes from the issuance of stamps. The nation state is a series of small atolls with highest elevation of 2 meters. As such the Tokelauns are on the front line when it come to climate change impacts related to rising sea levels. Currently 100% of Tokelau’s energy needs are met by solar energy. The SolarCoin foundation is interested in making a grant to Tokelau for the production of physical SolarCoin notes, which could then be sold by Tokelau at a premium. The grant would likely be matched with coins from community. The funds would be used by the general administrating government of Tokelau to aid the nation’s citizens.

2. Solarly Sub-Saharan Africa Development
   a. Solarly wants to support the development of remote communities in Sub-Saharan Africa by offering sustainable solutions adapted to their needs and respectful of their way of living. To achieve this, Solarly will implement connected decentralized and autonomous Solar Home System in order to make electricity access easier. We will be connecting our Solar Home System to the SolarCoin blockchain in order to claim SolarCoin on behalf of our clients. Also we will participate to the Electricchain project with the data we will be collecting. Amazing inspiring things could happen if goals are fully met, the projects “Why.”: We believe that SolarCoin will enable our Solar Home System to be more accessible to our clients by, firstly, reducing it’s purchasing price. Secondly, by offering our client financial services backed by the blockchain technologies / SolarCoin and altcoins.

3. Solar Vault
   a. The SolarCoin generator pool of 97.5 billion SolarCoin is a non-circulating asset that is put into circulation when verified claims for solar energy production are verified by affiliates and the foundation. The pool of offline solarcoin wallets is now worth a theoretical $6 billion USD. The pool needs to be secured and periodically accessible in a transparent way that meets the needs of community and security constraints for the next 40 years of the anticipated solarcoin project. Ideal end state is a fully geographically distributed secure monetary resource that is algorithmically secure and represents the goals and objectives of all Solarcoin stakeholders in a robust process for stable monetary policy and effective solar energy generation incentive.

Appendix

Partners

- IOTA - www.iotatoken.com
  o Iota is a completely decentralized micro-transactions cryptocurrency developed specifically for the ever-growing Internet-of-Things ecosystem. It's built on top of a new and novel innovation called ‘Tangle’, instead of a regular blockchain. This allows iota to remain extremely lightweight and efficient in the face of scalability issues that affect other platforms. Due to the novel technology implemented in Iota it is also a lot safer and resistant to future security breaches that loom for the current blockchains.

- Bitseed - www.bitseed.org
○ Bitseed is a plug-and-play Bitcoin full node device built in collaboration with a community of open source contributors. The invention of the Bitcoin protocol and blockchain technology has radically changed the world, streamlining business processes and providing users with greater security and autonomy. We created Bitseed so that anyone with an Internet connection can have easy, secure access to the blockchain.

- ElectriCChain - [www.electricchain.org](http://www.electricchain.org)
  ○ An Open Solar energy generation data project with an initial focus on verifying and publishing data from the 7 million solar energy generators globally on an open Blockchain. A public tool to monitor solar energy globally in near real time. The ElectriCChain project supports the development of open standards and tools to publish and read solar electricity generation data using the SolarCoin BlockChain and/or other blockchain technologies.

- Solcrypto - [www.solcrypto.com](http://www.solcrypto.com)
  ○ Solcrypto is developing IoT (Internet-of-Things) hardware and software technology with energy monitoring devices on the grid-edge that link directly with the decentralized global transparent SolarCoin blockchain and other blockchains. If you are a Solcrypto user, you will be able to participate in this exciting aspect soon. You will be able to link your Solar System to your user profile directly.

- SolarCoin - [www.solarcoin.org](http://www.solarcoin.org)
  ○ SolarCoin is a digital reward currency that works like air-miles for Solar electricity generation. SolarCoin is claimed by individuals living in homes with Solar Energy panels on their roof or large solar electricity farms. Solar energy, unlike fossil fuels, does not place excess heat or carbon into the atmosphere. The long term intent is to provide an incentive to produce more solar electricity globally over the next 40 years by rewarding the generators of solar electricity. SolarCoin is intended to shift the levelized cost of energy (LOCE).

- RWE - [www.rwe.com](http://www.rwe.com)
  ○ RWE AG, until 1990: Rheinisch-Westfälisches Elektrizitätswerk AG (Rhine-Westfalia Power Plant), is a German electric utilities company based in Essen, North Rhine-Westphalia. Through its various subsidiaries, the energy company supplies electricity and gas to more than 20 million electricity customers and 10 million gas customers, principally in Europe. RWE is the second largest electricity producer in Germany, and has increased renewable energy production in recent years.