



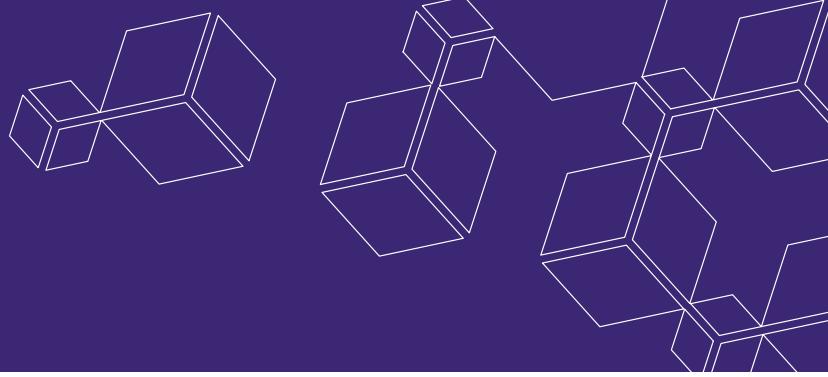
blockchain technology whitepaper

**Experts share their Blockchain
technology, development
and strategy know-how**



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Blockchain roundup: Invaluable advice from top blockchain experts

Is the blockchain just a hype? Can it offer an exponential benefit above other existing technologies? It's safe to say that blockchain is not going away, so people working in tech should have (at least) a base-level understanding of how this technology works.

Why the industries that make the world go round see tremendous potential in blockchain

Can blockchain transform the world? It is already doing that and, according to Chitra Ragavan, the Chief Communications Officer at Gem, a Los Angeles-based blockchain startup and one of our influencers, "blockchain technology has the potential to be transformative not only in the EU but throughout the world in coming years." What does that mean for us?

We invited nine influencers to weigh in on the facets of the blockchain and explain why the industries that make the world go round see tremendous potential in this technology.

It all started with one innocent question: **Can blockchain transform the world?** Although the answer is much more complex than a simple "yes/no", one cannot ignore the fact that this technology is changing (some might say disrupting) countless industries. Our influencers believe that blockchain will significantly change people's lives and improve citizen-government integration. Pain points are unlikely to go away but they are being addressed.

What about regulation? According to Perianne Boring, founder and president of the Chamber of Digital Commerce, the world's largest trade association representing the blockchain industry, "it is very important that we don't try to regulate this technology too early because it's still developing – we don't really know what it's going to be when it grows up yet." Meanwhile, Connor Svensson, founder of blk.io, a provider of enterprise blockchain platform based on Ethereum, states that "the need for support via law will not go away." In the end, it's just a matter of perspective.

Our influencers talked about their **concerns** (hype, complexity and our inability to understand the consequences of what we use it for, to name a few), the technology's **advantages** and **obstacles** and named a few **industries that cannot be disrupted** by the technology behind Bitcoin — Is it too vague to predict that all the industries where there are regulations can potentially benefit from blockchain in the long run? We don't think so.

Can/will/should blockchain eliminate the middleman? According to Chitra Ragavan, middlemen should watch their backs — "once the seismic shift settles, these intermediaries will end up offering other services that complement the new economic world order." Although blockchain could indeed eliminate the middleman, in some cases, there will be a place for them — one way or the other. Or, as Eoin Woods said, "those that are eliminated are the middlemen who aren't adding any inherent value to a transaction and are just keeping records and mediating in the transaction."

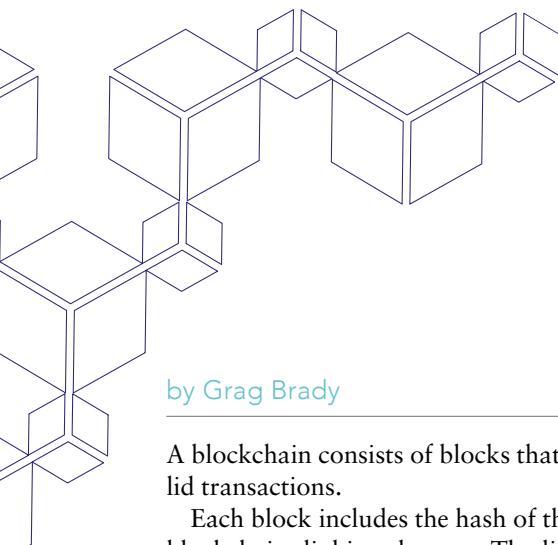
Finally, we asked: **What can the IT world learn from the blockchain technology?** Chitra Ravagan believes that disruption cannot be avoided and that "the winners will be the ones who can change their thinking towards this radical new way of approaching decentralized enterprise systems." Kathryn Harrison claims that "blockchain challenges the IT world to learn how to collaborate in new ways" and Conor Svensson opines that "as with any new or emerging technology, it's important for technologists to understand these technologies to ensure they are not taken by surprise when they become the new status quo."



What it is, what it's not, and what you can do with it

Blockchain: A technical primer

Gather around and I'll tell you the story of blockchain! In this article, Greg Brady, founder and CEO of Tranquility Halo explains what blockchain is and how to put it to good use. Kepp in mind though: even though Bitcoin and the Blockchain are intertwined, as long as the Bitcoin ecosystem continues to roar away, you can use the Blockchain to write anything down forever.



by Greg Brady

A blockchain consists of blocks that hold batches of valid transactions.

Each block includes the hash of the prior block in the blockchain, linking the two. The linked blocks form a chain.

In addition to a secure hash based history, any blockchain database has a specified algorithm for storing different versions of the history so that one with a higher value can be selected over others. Peers supporting the database don't have exactly the same version of the history at all times, rather they keep the highest scoring version of the database that they currently know of. Whenever a peer receives a higher scoring version (usually the old version with a single new block added), they extend or overwrite their own database and retransmit the improvement to their peers.

There is never an absolute guarantee that any particular entry will remain in the best version of the history forever. Blockchains are typically built to add the score of new blocks onto old blocks. There are incentives to only work on extending with new blocks rather than overwriting old blocks. The probability of an entry be-

coming superseded goes down as more blocks are built on top of it – eventually becoming very low.

In the context of bitcoin, the blockchain is a digital ledger that records every bitcoin transaction that has ever occurred.

A blockchain implementation consists of two kinds of records: transactions and blocks.

This short background will follow the The evolution of “Block Chain” technology.

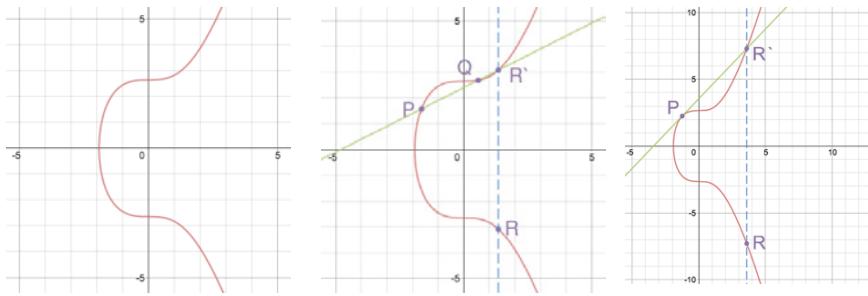
Elliptic Curves and Blockchain encryption

: Such as (a Third Degree Polynomial) has a specific known solution.

And Elliptic curves have a unique property, in that there is a way to “add” solutions of an elliptic curve together to get another solution.

Put simply, if you draw a line through the curve (that is not totally horizontal or vertical), it will always meet the curve at a third point. This is defined as adding Point P to Point Q.

The only exception to this is if a line is Tangential to the Elliptic curve. In this case, the line intersects the curve at one other point only. And this is defined as “Doubling” of point “P”.



In the above examples, point R is found by reflecting R' through the x axis.

Blockchain, Finite Fields and Hash Functions

A finite field, in the context of Elliptical Curve Digital Signature Algorithm (ECDSA), can be thought of as a predefined range of positive numbers within which every calculation must fall. Any number outside this range “wraps around” so as to fall within the range.

The simplest way to think about this is calculating remainders, as represented by the modulus (mod) operator. For example, 9/7 gives 1 with a remainder of 2:

$$9 \bmod 7 = 2$$

Here our finite field is modulo 7, and all mod operations over this field yield a result falling within a range from 0 to 6.

A Hash function is simply a rule applied to data to give a result – in this case, a number. For example, SHA256 is a Hash function that takes an input and has a 256 bit output. (SHA = Secure Hash Algorithm).

File >
Password > SHA256 > 256 bit number
Data >

In the case of SHA²⁵⁶ there are 2²⁵⁶ possible outcomes. (Another important Hash algorithm is RIPEMD160). Block Chain technologies (such as Bitcoin), use very large numbers for their base point, prime modulo and order.

The security of the algorithm relies on these values being large, and therefore impractical to brute force or reverse engineer.

In the case of bitcoin:

Elliptic curve equation: $y^2 = x^3 + 7$

Prime modulo = $2^{256} - 2^{32} - 2^9 - 2^8 - 2^7 - 2^6 - 2^4 - 1 =$
FFFFFFFFFF FFFFFFFFFFF FFFFFFFFFFF FFFFFFFFFFF FFFFFFFFFFF FFFFFFFFFFF FFFFFC2F

Base point = 04 79BE667E F9DCBBAC 55A06295
CE870B07 029BFCDB 2DCE28D9 59F2815B
16F81798 483ADA77 26A3C465 5DA4FBFC
0E1108A8 FD17B448 A6855419 9C47D08F
FB10D4B8

Order = FFFFFFFFFFF FFFFFFFFFFF FFFFFFFFFFF FBAEADCE6 AF48A03B BFD25E8C D0364141

Private and Public Keys and Wallets

To produce a “Private Key”, the Block Chain protocol chooses a point on the elliptical curve, eg. Point “E” i.e. The Base Point.

A Private Key is just a number – “N” (such that, $0 \leq N \leq 2^{256}$)

The Public Key associated with a Private Key is simply the Point “E”, added to itself “N” times. I.E. $P = Nx E$

For Bitcoin, the address associated with the key is the RIPEMD160 Hash of the SHA256 Hash of the Public Key.

Wallets are simply files that contain the Private and Public Keys and the addresses. Wallets usually contain many keys and may also contain labelling information for transactions, such as “Loan Payment” etc.

Digital Signatures and the Blockchain

The Elliptical Curve is used to construct a Digital Signature Algorithm to sign data. The data can be of any length. The first step is to “Hash” the data to create a number containing the same number of bits as the order of the curve (256). The mathematics is quietly involved, so for simplicity, I will just outline the steps. (If you require further information click here for a full worked example using small numbers.

1. Hash the Data to create a number containing the same number of bits as the order of the curve i.e. 256 bits.
2. Calculate the point $(x,y) = k * G$, using scalar multiplication.
3. Find $r = \text{mod } n$ (if $r = 0$ return to step 1). Modulo Arithmetic Calculator Here
4. Find $s = (z + r * d) / k \bmod n$. (If $s = 0$, return to step 1)
5. The signature pair is (r, s) .

To verify the signature with the Public Key, a third party would perform the following steps:

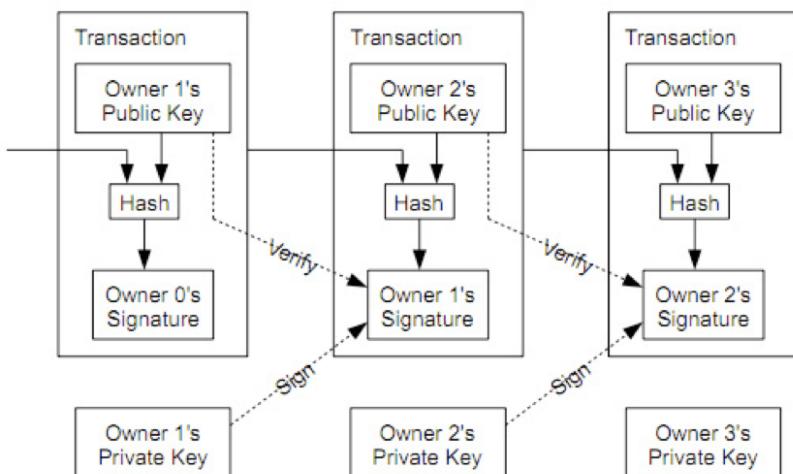
6. Verify r and s are between 1 and $n-1$
7. Calculate $w = s^{-1} \bmod n$
8. Calculate $u = z * w \bmod n$
9. Calculate $v = r * w \bmod n$
10. Calculate the point $(x, y) = uG + vQ$
11. Verify that $r = x \bmod n$. The signature is invalid if not.

“Bit Coin” Mining and the “Proof of Work” concept

Miners are not so much solving a math problem as they are spending a lot of effort making guesses until they guess correctly.

Bitcoin works by having a linked set of “blocks” of transaction records that document who has what bitcoin. To make bitcoin work, they needed some way to ensure that the record of blocks is immutable, i.e. nobody can change it.

The way they accomplished this was to create the concept of mining. Miners take a current set of transactions, which includes a link to the last set accepted, and make many trillions of guesses, each time putting a number into the “nonce” field of the block header. The block



header is run through a hash function, also known as a “one-way” or “trap-door” function. In this case, the SHA-256 hash function is used. If the output of the hash function is below a threshold value, then the block is valid, is accepted by other miners, and the miner who guessed correctly is rewarded with the block reward, in bitcoins.

The lower the hash function output threshold, the harder it is to provide a guess that will cause the output of the hash function to be low enough, and just how low the threshold is is determined by something called bitcoin “difficulty.” Difficulty adjusts every two weeks based

upon how much time it took to find the last $6 * 24 * 14$ worth of blocks: If it took only one week, then the “difficulty” should double – so that no matter how much mining is happening worldwide, a new block continues to be created every 10 minutes on average.

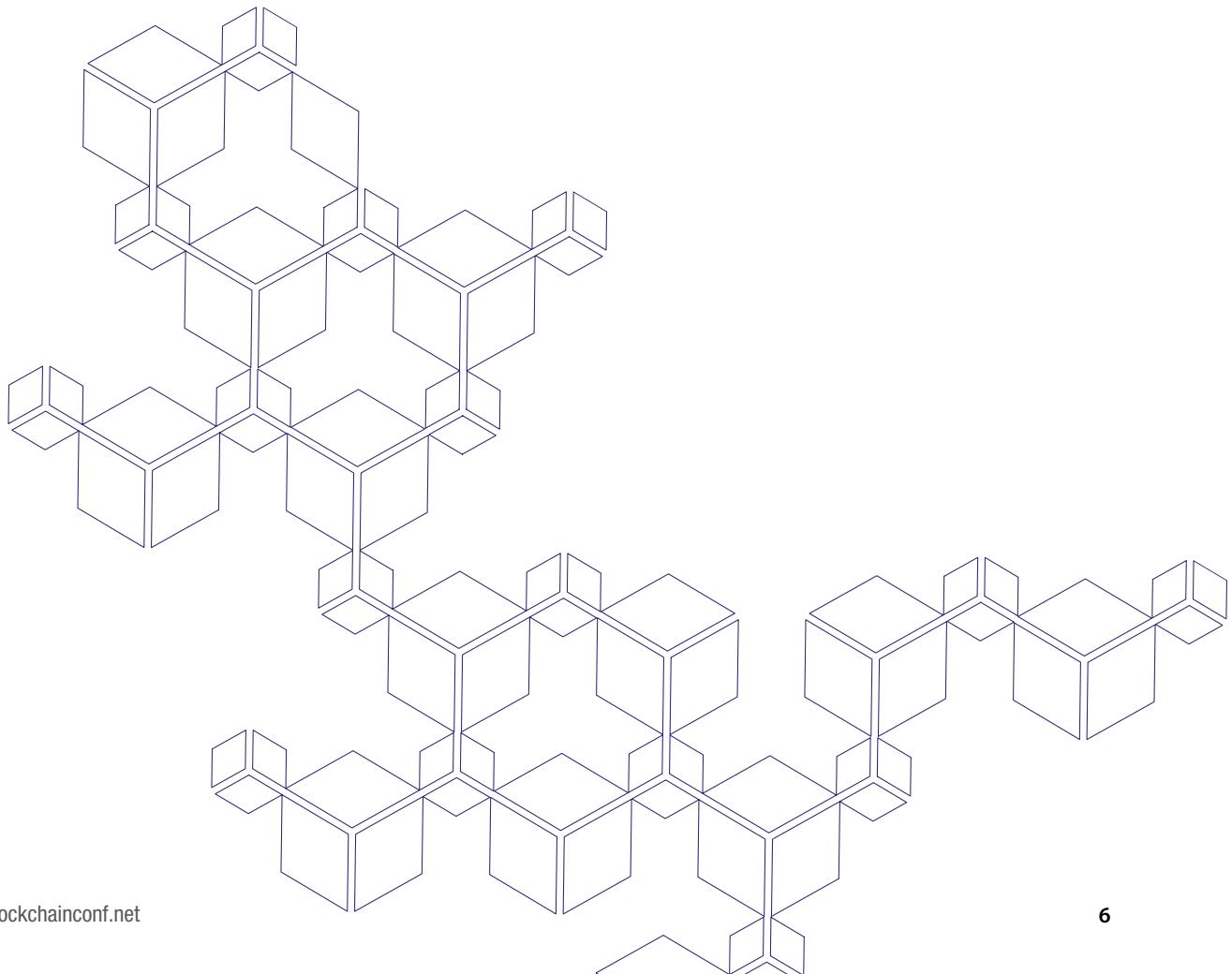
What you write in it, stays in it. Bitcoin is a currency that is the first asset tracked on the Blockchain, and because it is used to pay the miners, Bitcoin and the Blockchain are intertwined. But as long as the Bitcoin ecosystem continues to roar away, you can

use the Blockchain to write anything down forever.

This article was originally published on Tranquility Halo.



The irrepressible founder and CEO of Tranquility Halo – a Fin Tech genius – **Greg** is an innovative, cheeky and fun-loving team builder. He is always looking for a better way to do things. He thrives in a fluctuating environment and can transform obstacles into opportunity. Greg believes in listening hard first! A former Electronics Technician and qualified member of CPA Australia, his interests include golfing and surfing.





Interview with Eugene Kyselev, Blockchain Software Developer at Mobilunity

From Java to blockchain: How to become a blockchain developer

These days, blockchain is on everyone's lips. Many software developers from all sorts of fields are now trying to tap into the blockchain market. We talked with Eugene Kyselev, Blockchain Software Developer at Mobilunity, about his first steps into blockchain development and more.



JAXenter: Eugene, tell us more about your experience in blockchain development. How did you start?

Eugene Kyselev: As prosaic as it sounds, everything comes at the right time, and for me, blockchain development was a logical continuation. I started with JavaScript and other frameworks, and I wanted to continue to develop in that direction. A few years earlier, as this trend towards ICO and mining began, I unhesitatingly decided to try blockchain development.

Blockchain development is now moving at the speed of light. Blockchain technology has grabbed the attention of governments and central banks; in short, everything indicates that blockchain has a bright future.

JAXenter: How long do you think the “era of blockchain” will continue?

Eugene Kyselev: That's hard to say, that's like asking “How long will the era of globalization last?”

I think that as long as there is increasing demand for cryptocurrencies and other blockchain solutions, it will take a while. Absolutely everything and everyone goes through their own development, and even if the end would come for cryptocurrencies and various ICOs, I'm pretty sure that during the “blockchain era” there are still many other important discoveries and innovative applications of the blockchain technology that can lead to new breakthroughs in the whole industry.

JAXenter: Why should one change their technical specialization to blockchain development?

Eugene Kyselev: There is no such thing as the transfer of technical skills. Blockchain uses common programming languages such as C++, Java, Python, Go. But new technologies like Solidity will emerge. Solidity is an object-oriented programming language for developing



smart contracts for the Ethereum Blockchain platform. Another promising technology is Hyperledger, a blockchain platform comprised of open source technologies. Hyperledger lets you create distributed ledgers or your own blockchain frameworks.

JAXenter: Many developers are asking “What do you have to do to become a blockchain or crypto developer?” What would you recommend them?

Eugene Kyselev: With a strong will, you can achieve and learn everything. As a quick guide, I would recommend the IBM Blockchain 101 course. But for starters, you have to have solid knowledge of algorithms and data structures, most importantly cryptographic algorithms. If you’re a blockchain engineer, deep knowledge of Java / C or Python / Go is also a must.

If you’re focused on developing smart contracts, you need to have experience in JavaScript development, and the next step is to master Solidity.

JAXenter: How do you start writing Java Chaincode?

Eugene Kyselev: That’s totally easy. To get started, you need the following tools:

Gradle

JDK

Vagrant

First, start chaincode deployment:

```
peer chaincode deploy -l java -n map -p /opt/gopath/src/github.com/hyperledger/fabric/core/chaincode/shim/java -c {"Function": "init", "Args": ["a", "100", "b", "200"]}
```

Then, retrieve transfer transaction:

```
/opt/gopath/src/github.com/hyperledger/fabric/core/chaincode/shim/java $ peer chaincode invoke -l java -n 6d9a704d95284593fe802a5de89f84e86fb975f00830bc6c5595545ad689cd64791679e9 -c {"Function": "transfer", "Args": ["a", "b", "20"]}
```

After retrieving, initialize variables “a” and “b”:

```
/opt/gopath/src/github.com/hyperledger/fabric/core/chaincode/shim/java $ peer chaincode query -l java -n 6d9a704d95284593fe802a5de89f84e86fb975f00830bc6488713f9441b835cf32d9cd07b087b90e5cb57a88360f90a4de39521a5595545ad689cd64791679e9 -c {"Function": "query", "Args": ["a"]} {"Name": "a", "Amount": "80"}
```

```
/opt/gopath/src/github.com/hyperledger/fabric/core/chaincode/shim/java $ peer chaincode query -l java -n 6d9a704d95284593fe802a5de89f84e86fb975f00830bc6488713f9441b835cf32d9cd07b087b90e5cb57a88360f90a4de39521a5595545ad689cd64791679e9 -c {"Function": "query", "Args": ["b"]} {"Name": "b", "Amount": "220"}
```

JAXenter: Tell us a bit more about Hyperledger, R3 DLT, and Solidity.

Eugene Kyselev: Let’s start with Hyperledger. As mentioned above, it is an open source platform (hub) for blockchain applications. Overall, Hyperledger does not support Bitcoin and other cryptocurrencies. Hyperledger is a set of projects designed to facilitate the development of blockchain applications.

Since the emergence of the Internet, there has not been a technology as promising and groundbreaking as this technology. The internet and the blockchain can be used together to create a new generation of transactional applications that create trust, accountability, and transparency at the core of business processes.

R3 DLT is not a technology but a blockchain consortium that includes more than 100 banks, financial institutions, regulators, professional bodies, service companies and technology companies.

The goal is to use the platform to explore the possibilities of the blockchain technology, which is regarded as innovative, and at the same time to summarize the ideas and data of the established players, and make international payments faster and more reliable.

Solidity is a strongly JavaScript-oriented language designed to develop smart contracts running in the Ethereum Virtual Machine (EVM). Since Solidity has a JavaScript-like syntax, it made it easy for me to quickly master that language. The main drawback is that a full version of the language is not yet realized. Because of this, it still has a fairly limited set of functionalities and is plagued by many bugs.

JAXenter: There is a lot of hype around blockchain right now. What problems can be solved with this technology?

Eugene Kyselev:

Ensuring the safety of bank deposits

Every year, banks lose huge amounts of money due to fraud. Blockchain, with its almost impeccable safety, could help them solve this problem. Bank customers switching to a blockchain wallet are identified by a unique identification number instead of a name. In addition, they use a private key to access the money. With their help, only their owners can dispose of the funds — even the bank has no access to them. Such security measures have ensured the security of Bitcoin and other cryptocurrencies so that they can easily protect deposits.

Cloud storage on blockchain will be better able to withstand hacker attacks

Cloud storage companies use centralized servers to store data. For this reason, the risk that hackers can steal information from them increases — by accessing a server, hackers automatically penetrate the entire network. Cloud storage on a block of flats protects your data decentrally and their nodes are disconnected. Therefore,



they are less vulnerable to attacks, and even hacking a node does not hack the entire network.

Faster goods transportation

In logistics, there is a need to organize the transport of goods correctly and quickly. The key to this is the ability to track the goods throughout the supply chain. Thanks to the blockchain technology, this process will become much more secure and transparent. Moreover, continuous recording in decentralized registers will reduce the role of humans and the likelihood of delays.

Election fraud

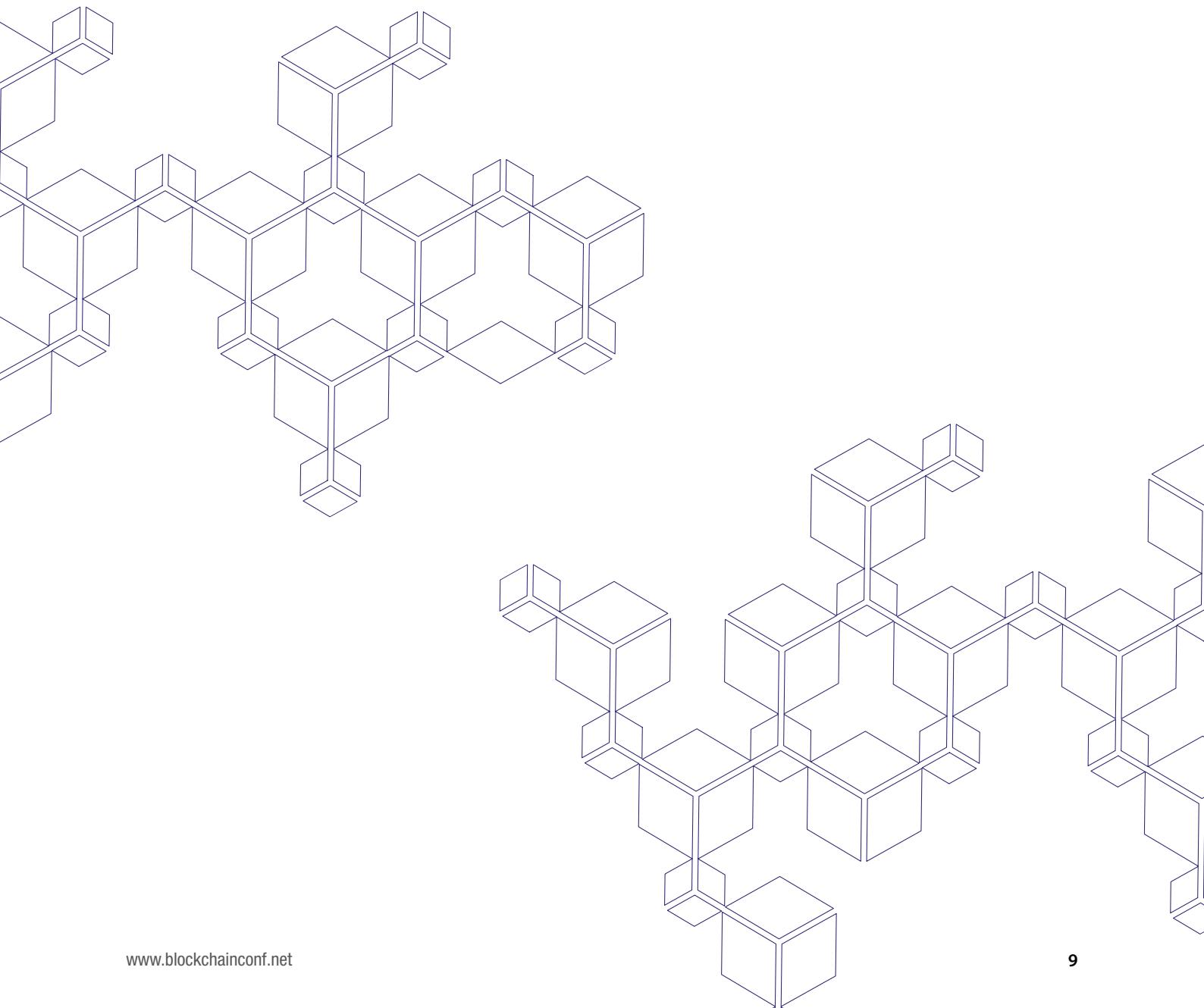
Electoral fraud, signature forgery, and the holding of meetings without notification to all members among the most widespread problems in corporate governance. All

of these problems are partially solved by the integration of the blockchain technology. For instance, it can track and count votes, thereby eliminating any chance that someone's voice will not be counted or falsified. Instead, each voting participant will receive a unique key to make a decision.

Thank you!



Eugene Kyselev is a blockchain software developer currently working for Mobilunity, located in Kiev, Ukraine. Eugene helps businesses across the globe to turn their tech dreams into reality. In his free time, he shares his knowledge of web development and innovative ideas with IT audience.





Start your journey as a dApp developer

dApps 101: Tips and tricks to get you started

You feel like you are not entirely sure what dApps are all about? Here, Michael Kordvani offers you some tips and tricks to start your journey as a dApp developer.

by Michael Kordvani

Despite the negative image of Bitcoin and other leading cryptocurrencies, one cannot deny that developing blockchain ecosystems is the future. Today's dApp developers have a bright future ahead of them.

Although it is still unknown to the vast majority of people around the globe, blockchain technology is powerful and legitimate. Even the well-known billionaire Mark Cuban, when talking about Ethereum-based tokens, recognized blockchain as the future of technology.

Having said that, you have to understand that getting started as a dApp developer—and building a “great platform for future technology”—is not that simple. After all, most programmers and developers simply do not understand what exactly a blockchain ecosystem is or why it is so powerful!

However, with a bit of studying and practice, you can get a solid start as a dApp developer. In fact, the purpose of this article is to help you build this skill by sharing the basic tips and tricks I learned during my (short) journey as a dApp developer.

Your dApp developer stack needs to include this

To be a dApp developer, you must make sure you have a scalable computation, storage for your files, external data, a monetization plan along with multiple ways to accept and make payments.

The great news is that it is much easier to build and maintain scalable computation, file storage, and external data in 2018 than it was in 2015. I would even go as far as saying that it was nearly impossible for most aspiring dApp developers, just three years ago, to build a scalable dApp in the comfort of their own home that was

actually worth the time, effort and cost. Today, though, I feel this goal is within the reach of most dApp developers.

Languages for dApp developers

Just like all programmers and developers, dApp developers must learn some specific languages. The best languages for this job are Web3 Solidity Documentation, JSON RPC API, and JavaScript AP. If you are not familiar with these three languages, you are not yet ready to start your journey as a dApp developer.

Monetizing your work as a dApp developer

As stated above, you want to monetize your dApp if you aim to become a successful dApp developer. As a starting point, all dApp developers should copyright their work. This is a painless and inexpensive task that will keep your work safe and secure.

Next, dApp developers need to decide on their method of payment. The most common payment options are allowing others to commercialize your dApp for a shared profit percentage, for the cost of a license, or for donations. Many dApp developers use more than one monetizing method.

Blockchain is most likely to keep taking the future of technological developments by storm. So, are you ready to be part of the future?



Ever since he was a child, **Michael** was captivated by technology. When the opportunity arose to spend his life writing about it, Michael didn't hesitate. He now spends his time exploring and writing about captivating new technologies to introduce to the people. Michael's insatiable desire for new technologies lead him to pursue a computer science degree at Queens College. His work has been published on various technology blogs across the web.



Interview with Dan Middleton, Hyperledger Sawtooth Project Maintainer

Making smart contracts safe with Hyperledger Sawtooth

Hyperledger Sawtooth 1.0 is now available — this is the second blockchain framework that has reached production-ready status. We talked with Dan Middleton, Hyperledger Sawtooth Project Maintainer about its differentiating features, the difference between Sawtooth and Fabric and what's under its hood.

JAXenter: Hyperledger Sawtooth 1.0 has just been released. What's the star feature of this milestone?

Dan Middleton: Since Hyperledger focuses on enterprise-grade blockchain technologies and is recognized as one of the leaders (rather than focusing on cryptocurrency), this is a major milestone for the Hyperledger technical community. Sawtooth has a number of differentiating features you'll see listed below. The distinction for a 1.0 release, though, is not features but maturity. See #6 for a fuller description of what that means.

In a nutshell, though it means the code has been rigorously tested and reviewed, the platform has been field tested, and you can build your apps on the API without fear of it changing and breaking your apps — an issue that plagued many companies starting out with other blockchains.

JAXenter: One of Hyperledger Sawtooth's unique capabilities is that it allows you to program smart contracts in your preferred language, with support including Go, JavaScript, and Python, to name a few. Is Go a good language for programming smart contracts and/or building blockchains?

Dan Middleton: Sawtooth has SDKs for building blockchain applications in a variety of languages. Some languages will be better choices for the client-side and others for the server-side. An example could be JavaScript to make the client front end and go-lang for the backend (what is commonly referred to as a smart contract).

Typically the backend or smart contract part of the application should be written in a performant language, and the client language should be selected for UI or client device considerations. This is not to say you can't write everything in the same language. Many of our examples use Python on both sides because it's easy to read. Our intent in providing a variety of SDKs is that not only can you select the right technology, but also you can use the language(s) for which your company has experience and staff.

JAXenter: What's the difference between Sawtooth and Fabric? Could you name some of the applications for Sawtooth?

Dan Middleton: Hyperledger Sawtooth 1.0 and Hyperledger Fabric 1.0 are both stable frameworks hosted by Hyperledger. Hyperledger Sawtooth's design phi-



losophy targets keeping distributed ledgers distributed and making smart contracts safe — particularly for enterprise use. Sawtooth is the first project to release with Byzantine Fault Tolerance options. This is a higher level of robustness than Crash Fault Tolerance.

Sawtooth also uniquely offers “global state agreement,” an assurance that each node has cryptographically identical copies of the blockchain database. Sawtooth also lets you program business logic (smart contracts) in your language of choice. Further Sawtooth can execute transactions in parallel for higher throughput.

So to summarize, Sawtooth 1.0 also differs from Fabric 1.0 in including

- State agreement (cryptographically verifiable databases)
- Byzantine Fault Tolerant Consensus
- Unpluggable consensus
- Multi-language support
- Parallel Transaction execution

JAXenter: Can it integrate with different blockchain technologies?

Dan Middleton: Yes, in August, an initial proof-of-concept integration between the Hyperledger Sawtooth and Hyperledger Burrow projects was completed. As a result of this integration, EVM smart contracts can be deployed to Hyperledger Sawtooth using the “Seth” (Sawtooth Ethereum) Transaction Family.

JAXenter: What is under its hood? How has it evolved since its early days at Intel?

Dan Middleton: Sawtooth started out as a research project that discovered two important innovations (PoET and Transaction Families). Since contributing it to Hyperledger, the code has been used by many companies which helped the emerging Sawtooth community discover and solve new problems. The internals have been completely rewritten from the original research code and now provide a host of new capabilities written to solve challenges exposed during field testing in enterprise environments.

A few of the features included in Hyperledger Sawtooth v1.0 include:

On-chain governance – Utilize smart contracts to vote on blockchain configuration settings such as the allowed participants and smart contracts.

Advanced transaction execution engine – Process transactions in parallel to accelerate block creation and validation.

Support for Ethereum – Run solidity smart contracts and integrate with Ethereum tooling.

Dynamic consensus – Modify the blockchain consensus protocol on the fly as your network grows, enabling you to integrate more scalable algorithms as they are available.

Broad Language Support – Program safe smart contracts in your preferred language, with support including Java, JavaScript, Python, and more.

SEE ALSO: “You could think of Hyperledger Fabric kind of like an Apache Web Server”

JAXenter: What should people understand at this point in this project’s maturation?

Dan Middleton: This Hyperledger Sawtooth 1.0 release is the culmination of work from several companies intent on creating a distributed ledger designed for the enterprise. We would not have the rich features or deployment maturity today without the collaboration and contributions from these and other organizations (alphabetically): Active Ticketing, Amazon Web Services, Bitwise.io, Cloudsoft, Context Labs, Dot BC Media, Ericsson, Hacera, Huawei, IBM, Intel, Microsoft Azure, Monax, Open Music Initiative, PokitDok, R3, T-Mobile, Wind River, and several independent engineers.

Part of the run-up to our 1.0 release involved a strong shift from feature development to stability and stress testing. Each code change works its way through a sophisticated Continuous Integration testing process. Further, each release candidate build goes through an additional multi-day multi-node testnet evaluation. The code has also undergone static analysis and pen testing by 3rd party auditors.

Of course, all projects have bugs, and we will continue to find and fix these in Sawtooth, but the balance of investment and contribution from the community over the last several months has been to harden and mature the platform. Finally, there’s a commitment from the Sawtooth maintainers that the 1.0 API won’t change underneath you. Your company can feel confident building on that API knowing that future enhancements and fixes will be backwards compatible in point releases.



Dan Middleton is the Hyperledger Sawtooth Project Maintainer.



Interview with Alfred Shaffir, co-founder at iOlite Foundation

“The currently unrivaled programming language for smart contracts is Solidity for the Ethereum blockchain”

iOlite Foundation recently introduced a smart human-machine translator to convert code back and forth between blockchain virtual machine code and various interfaces. In short, it's now easier to create smart contracts on the blockchain; plus, you don't need to learn a specific programming language. We talked with Alfred Shaffir, co-founder at iOlite Foundation about all this and more.

JAXenter: iOlite Foundation just launched a smart human-machine translator to convert code back and forth between blockchain virtual machine code and various interfaces, include popular programming languages. Which languages are we talking about?

Alfred Shaffir: If you are not good at Solidity, you can use your own language to create smart contracts! To assist those who want to build smart contracts, iOlite intends to build a platform that will allow anyone to write high-quality smart contracts using various languages, both spoken (like English or Russian) and programming (like Java, C++, Python, etc.) This platform will utilize blockchain and machine learning technologies that will accept text in any language as an input, and then instantly convert it into smart contracts with the help of iOlite's Fast Adoption Engine (FAE.)”

JAXenter: Is this basically Google Translate for blockchain-powered smart contracts? How would that work?

Alfred Shaffir: Translator is not the best word as it is more of a converter. We've officially called a Fast Adap-

tation Engine. iOlite is a blockchain-based platform that simplifies the human-machine interface and also makes it easier to create smart contracts. Our organization, iOlite Foundation, is a non-profit that aims to make smart contracts adaptable in the real world, by converting smart contracts written in other programming languages, such as JavaScript or C++, into smart contract languages such as Solidity. We are also working on the conversion of input text in natural languages into smart contract code using its Fast Adaptation Engine (FAE). We ultimately want to create a pool of vocabularies (word structure definitions) and solutions for various contracts used for different applications.

JAXenter: What is the immediate benefit of having a smart human-machine translator?

Alfred Shaffir: An immediate increase in operational efficiency. Processes that required the involvement of a programmer, such as BOT creation, website, app etc, will now be created by the very people that needed them in the first place. Saving time and money. It allows rapid



prototyping as well and gives business who are using iO-lite the opportunity to create new business models based on our FAE technology.

JAXenter: Before this translator, what was the best programming language to create smart contracts on the blockchain?

Alfred Shaffir: The currently unrivaled smart contracts programming language is Solidity for the Ethereum blockchain.

JAXenter: iOLite is motivated by major achievements within the machine learning industry. What do you mean by that?

Alfred Shaffir: We are using the Stanford NLP engine which is a very strong piece of ML. Game which uses this engine (we made a derived version with tokens on the blockchain). Here's the research paper on Stanford NLP.

JAXenter: How can we bridge the gap between mainstream developers and blockchain specialists? How easy/hard is it for developers to write their own smart contracts?

Alfred Shaffir: It's not easy if it is a centralized solution or created by a centralized organization. This is because leading programming languages are changing and to cover a full language it would be practically impossible due endless updates and possibilities, e.g. today it's Solidity for Ethereum tomorrow it will be another trending blockchain with its own programming language.

On the other hand, when the language required to be "gapped" is being required by the community, the same community out of which experts are assisting in creating the necessary "bridging", this would have the necessary flexibility and generic solution that will work.

JAXenter: How much value is stored in smart contracts? What can they actually do and what are the misconceptions about them?

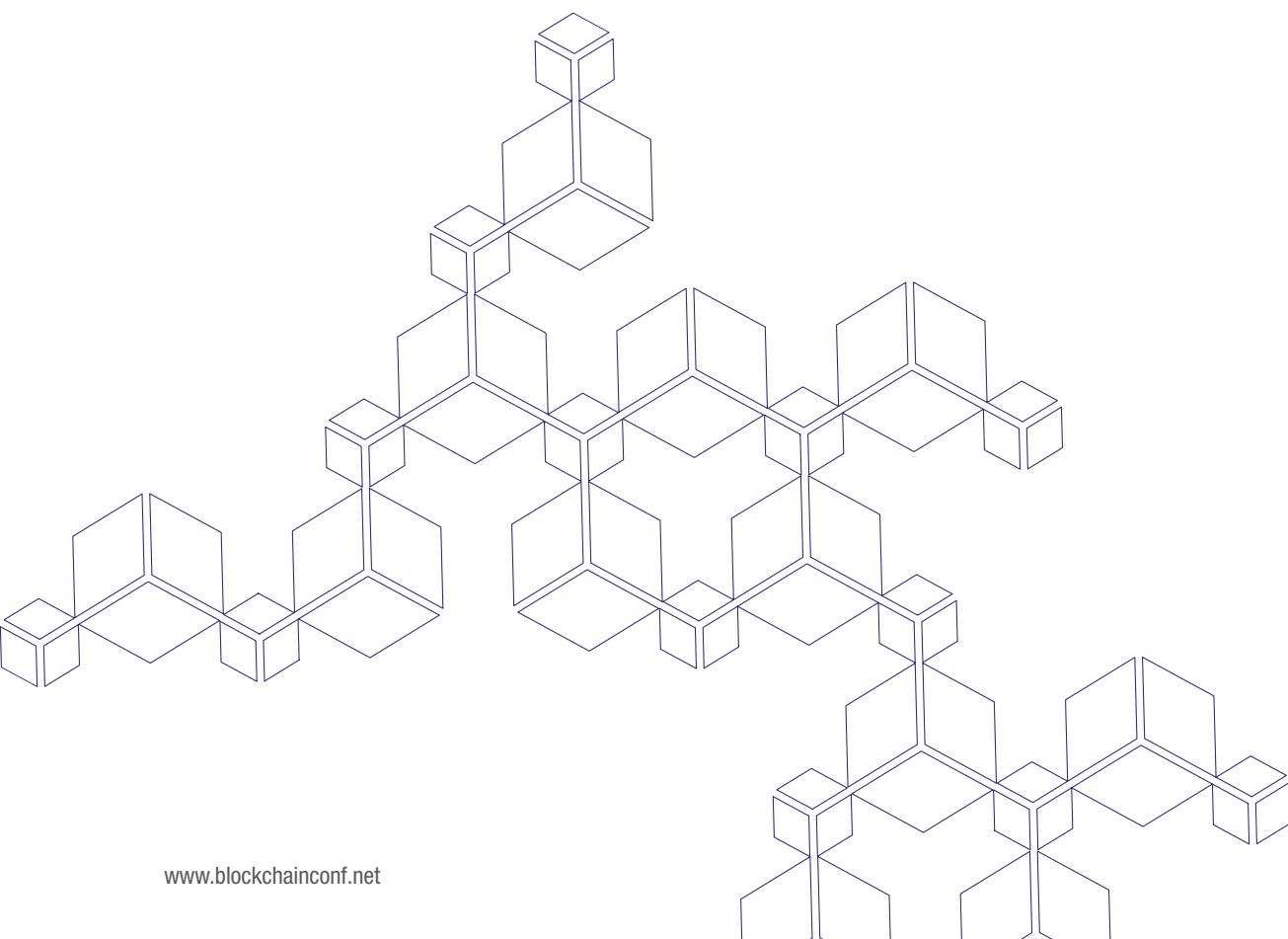
Alfred Shaffir: A smart contract is a relatively very small program. An app that is executed/running at the same time on a distributed network of processing units, nodes, i.e a Blockchain.

The value stored in these smart contracts is derived from the underlying deal which they represent. The simplest example would be different contribution levels during a token sale event. Some smart contracts will have bigger amounts than others.

One of the misconceptions about smart contracts is that they are "Smart." Smart contracts are pretty simple programs with well defined logical conditions. They are as smart and the programmers that wrote and audited them.



Alfred Shaffir is a serial entrepreneur who has managed three startups: Seanernet, an infrastructure for Internet access at sea; Polycoin, a cryptocurrency-blockchain processing platform; and Folloyu, a web mobile technology. He has also led global teams at Intel and Cadence Design Systems. Alfred holds a B.Sc. in mechanical engineering from Tel Aviv University and an MBA from Bar-Ilan University.





Step-by-step tutorial

Programming a crypto mining rig: How does it work?

There are currently over five industries where the services of blockchain programmers are required. However, without the right set of skills to program the blockchain, you won't be able to tap into this market's potential. In this article, Amir Gvili teaches you how to program a crypto mining rig.

by Amir Gvili

Last year, cryptocurrencies enjoyed a massive amount of media attention. Bitcoin's value skyrocketing from about \$800 in December 2016 to \$20,000 by the end of 2017 has given lots of people reasons to invest or make effort and earn money off cryptocurrencies. For many developers, investing, mining and programming the blockchain technology are the best options.

Investing in Bitcoins

Computer programmers, bloggers, and IT enthusiasts were among the very first groups of people to invest in bitcoins. The world's first bitcoin billionaires, besides its founder, were computer developers who had previously sued Facebook's Mark Zuckerberg for allegedly stealing their idea while studying together at Harvard. These days, almost everyone with an idea about bitcoin can invest.

Blockchain programming

Naturally, programming should be the best option for any computer developer who enjoys coding. As cryptocurrencies continue to gain wider adoption, applications for the blockchain technology are increasing:

The blockchain is a digital ledger of facts (records) that are arranged in groups of data referred to as blocks.

These blocks are interlinked, and each time a block is completed, a new one is opened.

The blocks are interlinked through a secure validation system known as hashing. When linked together, blocks complete a blockchain.

The blockchain uses a peer to peer system for storing data, meaning that records validated are stored in multiple locations and fact-checked every few minutes.

Currently, there are more than five industries where the services of blockchain programmers are required. Blockchain startups are certainly the biggest employers, with some networks offering starting salaries of up to \$100,000.

While investing in cryptocurrencies and programming the blockchain network are the most lucrative options for a programmer, they come with challenges. A coding enthusiast without money to invest will definitely be locked out of the cryptocurrency craze happening today. On the other hand, without the right set of skills to program the blockchain, you won't get employed.

How to program a crypto mining rig?

Mining, the process of validating transactions on the blockchain, continues to become competitive as more people become miners. Mining bitcoins, for example, is now more difficult and demands much more sophisticated hardware. Add that to the fact that the reward



to complete a blockchain is halved every four years and you get reasons as to why more coders are shifting toward mining altcoins. View these statistics about how altcoins performed in offering value to miners and investors in 2017 and you might get convinced to program a mining rig for Ethereum, Litecoin or any other valuable altcoin:

Neo coin gave investors a return of 31620.81%.
PIVS returned 25971.53%.
BitBean returned 8441.22%
Ethereum returned 3683.83%
Ripple returned 2332.16%
Dash coin returned 1968.06%
Litecoin returned 920.09%.
Dogecoin returned 685.20%
Monero returned 251.63%.
Bitcoin returned 355.31%.

Compared to Bitcoin, most altcoins offered greater returns to miners in 2017. This year, the trend is expected to follow a similar path. Most altcoins that rely on a blockchain to store records are in great need of miners. The rigs you need to mine altcoins are inexpensive and easy to program.

Follow the guide below to program a 6 GPU Litecoin mining rig.

Components to buy

Motherboard—find a powerful motherboard that can also offer services for long.

Power supply unit-mining is a huge consumer of power. Find a PSU rated between 750watts and 2000 watts depending on your needs.

Graphics Cards—purchase high-quality 4-6 GPUs, each with speeds of 450kh/s or higher.

RAM — you need at least 4GB RAM for a dedicated Litecoin mining rig. You may need to add more RAM depending on the software you use.

Powered riser cables—riser cables help connect the graphic cards to the motherboard while leaving space for heat dissipation.

Hard drive — a solid state drive of between 60GB and 120GB is enough for a dedicated mining rig.

A fan to provide extra cooling.

Linux operating system — Linux is considered the best operating system for mining litecoin. It keeps the heat down and helps improve your return on investment in the long run. However, Windows OS or IOS are still great alternatives.

Accessories — you will need a monitor, keyboard, mouse and USB cables, especially when programming the rig.

A case—purchase a special mining case to keep the components in place or build one with readily available materials.

Assemble the components

Unpack the components. Start by installing RAM and the processor. Plug in riser cables and plug in your solid

state drive. Connect the GPUs, power supply, and all other accessories. Ensure your GPU drivers are updated before you can head on to the next stage. Install an operating system and head on to your next programming stage:

Install GPU software for the rig

Most developers use cgminer as the preferred software program for mining Litecoins. Cgminer is freely available on the developer's website or through unofficial binaries for Mac users. Download the program and follow the following command line arguments:

Extract cgminer into a folder. Give the folder a name you will easily remember.

Press the Windows key and the "R" key at the same time.

Type "cmd" and press "enter."

Use the cd command on the command terminal and change the directory to the location where you stored the cgminer zip file.

Type "cgminer.exe -n"

A list of available devices on your computer will appear. Your graphics cards should appear. If they don't appear, make proper configurations.

At this stage, you should have a cryptocurrency wallet and your mining pool's details. It's important that you join a mining pool as mining alone is never feasible. It takes longer to complete a blockchain, sometimes even years. Access your mining pool details and structure the cgminer accordingly. Here is a guide:

"C:\Cgminer\"

URL to the mining pool server.

Port number of the server.

Your user name

Your worker name

Password.

You may go the extra mile and link your GPU miner with your computer's CPU cores for faster mining. Access the "miner" command and add the number of CPU cores you wish to dedicate to mining. The cgminer software will show you the hash speed of both CPU and GPU units. On average, the GPU speed will be five times faster than CPU mining.

To sum up

Programming a Litecoin mining rig isn't difficult, is it? However, getting the above components together takes time. Some can also be expensive. Take time and assess your options. If you can afford ASIC mining rigs, they are much more efficient. If you find a manually assembled rig more convenient, go for it.

Hopefully, everything works out for you as you program your first rig.



Amir Gvili, is the manager of [aBitGreedy.com](#), a cryptocurrency trading guide for beginners and experts.

How Can Blockchain Technology Help Boost Cyber Security?

Solving the cybercrime problem is an important process of letting technology continue quality development. In terms of cybersecurity, blockchain technology offers much more than the usual centralized system or database.

by Victor Stolyarenko

Knowing that nobody can be trusted, we have built various institutions and created rules that are supposed to help us communicate in a way that can provide a certain level of security over personal paranoia. But then, courts still exist; therefore, the problem does, too.

Take into consideration the fact that what we know about blockchain is knowledge accumulated in just over 10 years of selective use. Still, many would mistakenly regard it as if it were solely related to cryptocurrency, and fail to see the full potential it offers. At Applicature.com, we know where the best fruits are hidden.

How Can Blockchain Help Boost Security?

Blockchain features that contribute to the highest level of security are based on the following:

- the distributed ledger
- the consensus aspect
- heavy encryption

To Secure, You Encrypt

Thanks to mathematically-proven computer algorithms, blockchain could let one forget about the pro-

blems of weak passwords and compromised or stolen data.

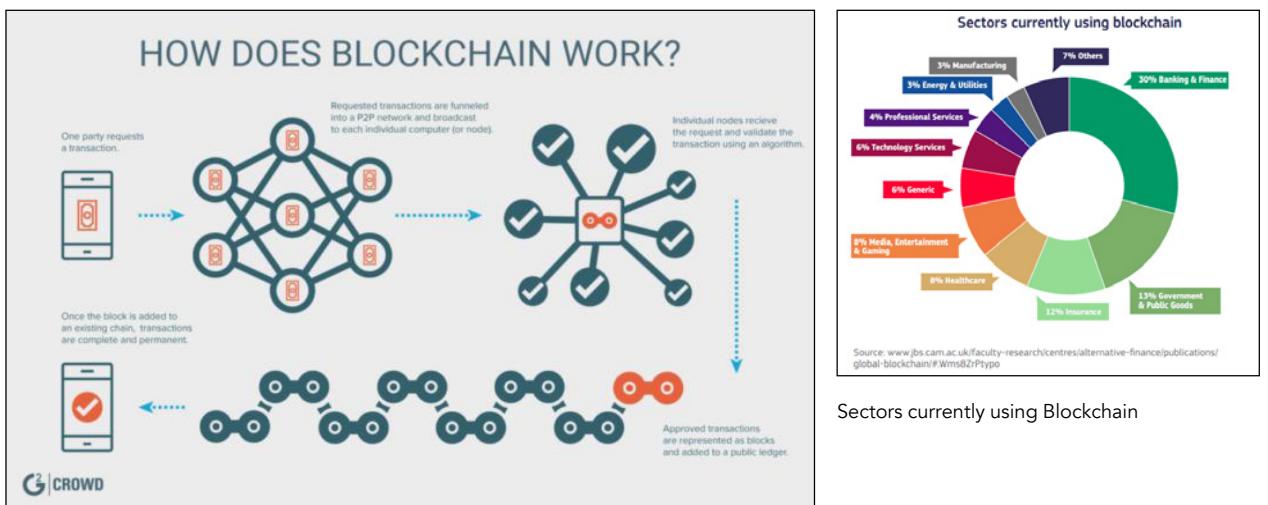
Because it is quite plastic, blockchain can be used to boost cybersecurity in practically any case you can think of, simply by eliminating what causes the greatest number of failures: the human factor. Writing a smart contract for an ICO can contribute extensively to this new and heightened degree of security. If well-constructed, a project powered by self-executing contracts offers a great experience on the level of both security and verifiability.

Consensus: Public and Private Blockchain

In a public blockchain, all participants can be responsible for storing data and verifying transactions.

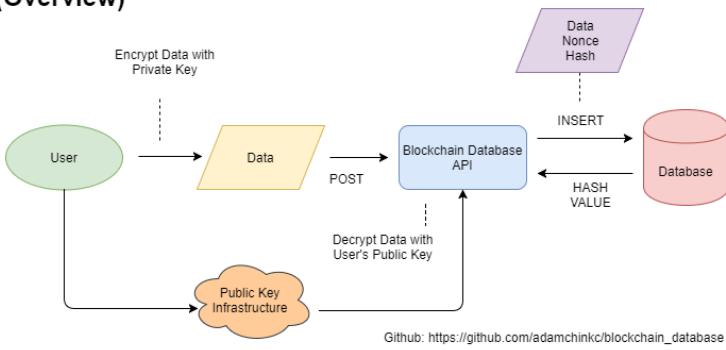
In a private blockchain, the task of verifying transactions is laid upon a selected group of nodes rather than all users. To be able to join a private network, a user would need to be invited by an existing participant, or be one of the group of "the chosen" from the start of the network.

Even though a private network is not as democratic and open for everyone as a public one, it can be a great first step toward adoption of a fully decentralized model.

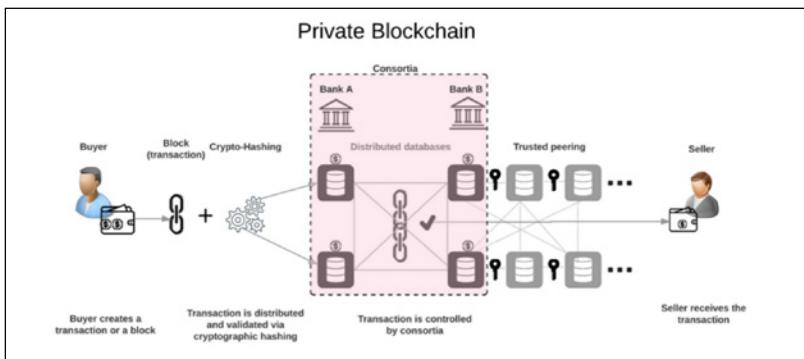


How does Blockchain work?

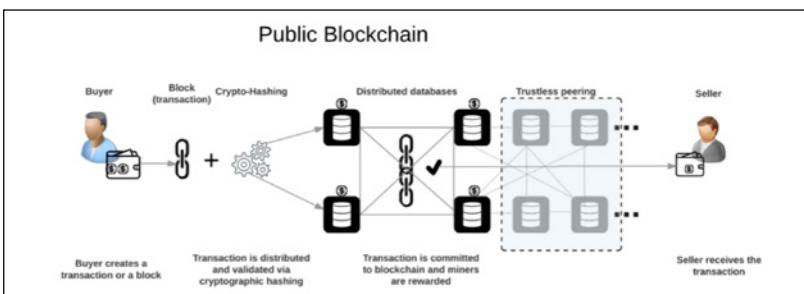
Database based on Blockchain's Data Architecture (Overview)



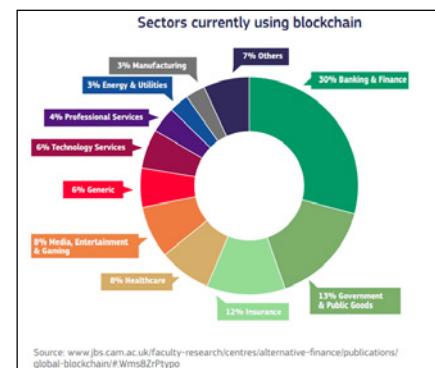
Blockchain Data Architecture



Public Blockchain



Private Blockchain



Sectors currently using Blockchain

Decentralization and Its Share of the Security Aspect

In the world of humans, trust issues have not yet been eliminated, and therefore, technology exists in a constant loop of opposition where to every action there is a counteraction. To escape this, you have to solve a fundamental issue and then slightly change the course so that to postpone the failure day.

One existing problem is a denial-of-service attack, a very obvious counteraction to any centralized system that has shown us how far from perfection the way we store and communicate data online really is. Doing the counteraction, the distributed and decentralized nature of blockchain leaves DDoS attackers no chance, as it is next to impossible to attack all nodes simultaneously.

The Application of Blockchain

Interacting online is not always safe for the regular user, and it's sometimes even dangerous if you have a business running on an internet platform. In 2018, technology has already developed into a whole separate world. It has touched and influenced every aspect of real life, turning internet- and technology-based reality into a much simpler and more organized process.

If you think about it, all kinds of real-world services are represented in the cyber world, and very often, it is technology that offers a much better experience. With blockchain in use, who knows what new applications are yet to be discovered?

Interview with Paolo Tasca, Director at the Centre for Blockchain Technologies at University College London

Overledger aims to open blockchain's "borders" and facilitate development of multi-chain applications

Enabling cross-chain communications is just like opening borders to allow international trade. Overledger ensures that companies and developers have the flexibility to easily migrate to another technology when required. We talked with Paolo Tasca about the first blockchain operating system that facilitates the development of multi-chain applications and the value it brings to the blockchain technology.

JAXenter: What is Overledger and what value does it bring to the blockchain technology?

Paolo Tasca: Overledger is the blockchain operating system that enables interoperability between blockchains and connects the world's existing networks and the Internet to blockchain.

Overledger encourages innovation by allowing developers to build applications across multiple ledgers or multi-chain applications (MApps), meaning that developers can harness the power of multiple individual blockchains to build the most effective solution instead of being confined to just one ('single-ledger dependency').

JAXenter: A lot of companies are experimenting with blockchain behind closed doors but most blockchain-related projects are not ready to face (and address) real-world challenges. How can Overledger help with that? How can companies harness the power of blockchain to address real-world challenges?

Paolo Tasca: Overledger not only enables blockchain-to-blockchain communication, it also takes things a step further and seamlessly connects existing networks and the Internet to blockchain, allowing Enterprises to harness the power of blockchain to address real-world challenges.

JAXenter: The blockchain technology has gone from being the "shady" technology behind Bitcoin to a legitimate tech disruptor. Despite its popularity, this technolo-

logy is yet to be adopted on mass. What are the limitations that prevent blockchain from going mainstream?

Paolo Tasca: Not since the advent of the Internet itself has a technology exhibited such promise and elicited such excitement as blockchain. In recent years we've witnessed its metamorphosis from a 'dubious' experiment into a legitimate technological disruptor.

Every day, more and more Enterprises (and consumers) are turning to blockchain for solutions to modern-day challenges — from the pharmaceutical sector securing global supply chains to consumers being able to verify the authenticity of their high-end sneakers. The technology is yet to be adopted on mass, however. This is in part due to its current limitations, which include the inability of blockchains to communicate and work with each other at an Enterprise level.

JAXenter: How can Overledger change that?

Paolo Tasca: The launch of the patented blockchain operating system Overledger will fundamentally change the current situation as it not only enables interoperability between blockchains but also connects the world's existing networks and the Internet to blockchain. Furthermore, it allows developers to build applications across multiple ledgers or multi-chain applications (MApps), meaning that developers can harness the power of multiple individual blockchains to build the most effective solution instead of being confined to just one ('single-ledger dependency').

JAXenter: Do companies have to change everything in order to connect to blockchain or has it become easier to include blockchain in a company's backbone?

Paolo Tasca: Overledger ensures that companies and developers aren't restricted to or dependent on a single technology. Instead, they have the flexibility to easily migrate to another technology when required. As well as boosting their resilience by limiting their risk and exposure, this also allows them to unlock cost savings by better managing consensus fees, which are set with no option to remediate.

The Quant Network team (founded by industry experts) recognises that addressing interoperability in the siloed cryptosphere is a complex challenge and not a novel concept, but they are confident that the Overledger platform and protocols will successfully do just that.

When we designed Overledger, we were acutely aware of the challenges facing companies across the public and private sectors, based on our extensive first-hand experience as former executives of large enterprises both in the private and public sector.

As such, we not only recognise the tangible solutions that blockchain offers businesses but also know only too well just what a complex challenge it can be for a large company to adopt any new technology. That is why we've engineered the Overledger technology for Enterprises and developers to be seamless to implement and compliant with internal and external security and regulatory requirements. This means that a company need make only minimal changes to its

existing systems and networks in order to connect to blockchain.

JAXenter: Is blockchain part of (or leading) the fourth industrial revolution?

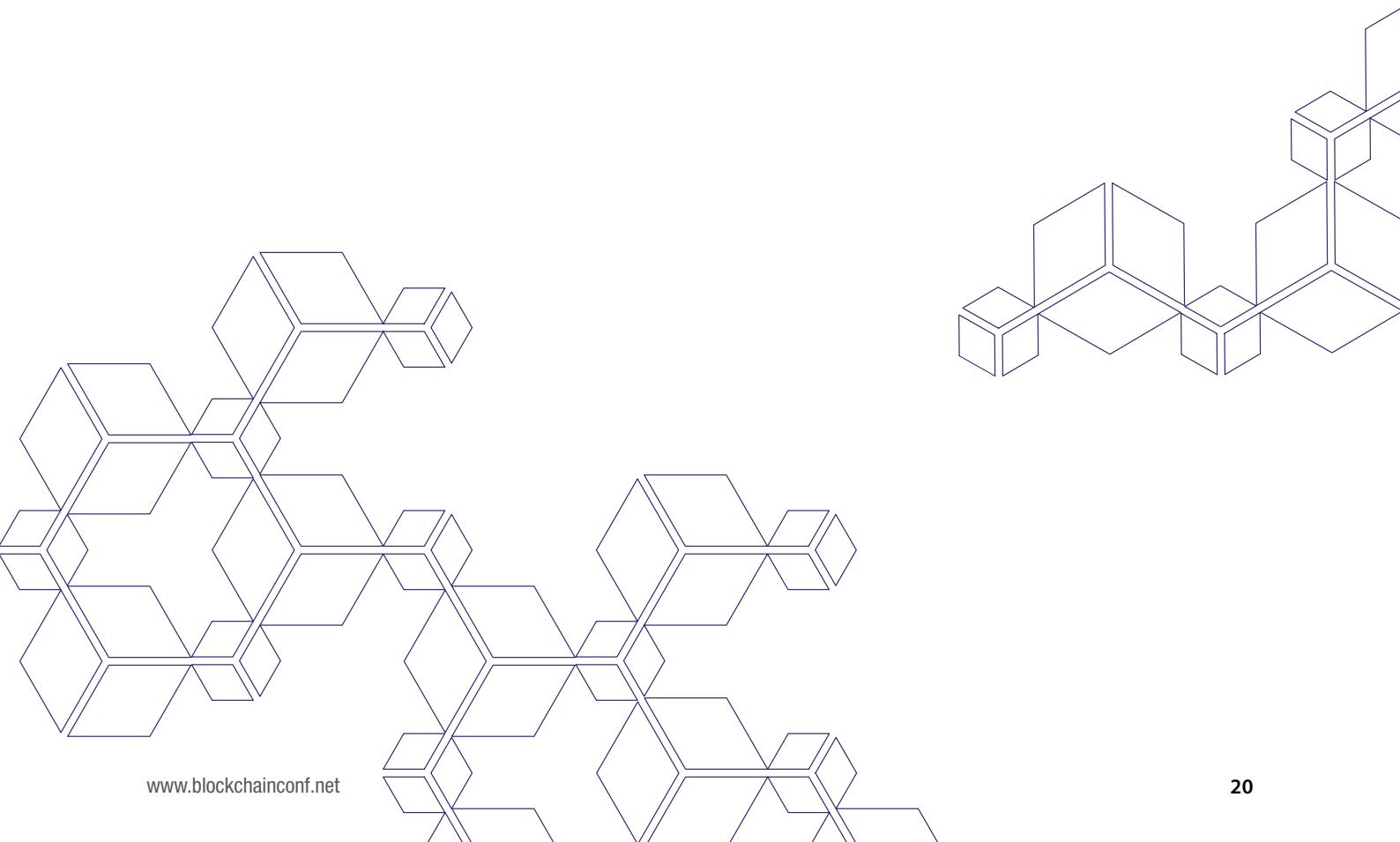
Paolo Tasca: Enabling cross-chain communications—including the recognition and transfer of transactions—is not dissimilar to opening borders to allow international trade. It will usher in a new era of digital economic growth and prosperity not unlike the industrial revolutions of the past.

We have witnessed a similar effect in the early days of the Internet, where closed networks such as AmericaOnline and Prodigy flourished once they had connected seamlessly using standard protocols, the promise of a new revolution may be closer than we think.

Thank you!



Paolo Tasca is a FinTech economist specialising in P2P financial systems. An advisor on blockchain technologies for different international organisations including the EU Parliament and the United Nations, Paolo is founder and Executive Director of the Centre for Blockchain Technologies (UCL CBT) at University College London. Previously, he was Lead Economist on digital currencies and P2P financial systems at Deutsche Bundesbank, Frankfurt. Paolo is the co-author of the bestseller FINTECH Book and the co-editor of the book Banking Beyond Banks and Money. In addition, he is author of various scientific papers about blockchain, which have been published by prestigious international scientific journals, such as the Harvard Business Review.



The current blockchain education space

School is in session: Blockchain education is needed ahead of mainstream adoption

There is a pronounced shortage of developers qualified in building decentralized, scalable blockchain systems and applications. The question is, how can we provide the educational support that this new generation of logical thinkers requires?

by Nikola Stojano

Cryptocurrencies and the idea of “blockchain technology” have never been so popular. With more than \$5.5 billion USD raised in 2017 from a total of 445 ICOs, even taxi drivers are now exposed to the emerging global crypto-economy. History has taught us that the pace of human greed (in the form of the infamous “FOMO”) can only be matched by the speed of misinformation. Although the lack of proper understanding of blockchain technology fundamentals sometimes seems inversely correlated to the total market cap.

However, the current situation of rising prices creates a major opportunity in the form of a challenge. There is a pronounced shortage of developers qualified in building decentralized, scalable blockchain systems and applications. The question is, how can we provide the educational support that this new generation of logical thinkers requires?

Where are we now?

Blockchain developers are currently enjoying a rockstar status. Much like in the case of web-developers in 1997 and app-developers in 2008, they are in very high demand. There are only several top quality developers who are capable of creating valuable, distributed architectures, and most of them have founded their own projects.

Globally, 7,000-8,000 people can develop for the blockchain with various levels of proficiency. These individuals are either short on time or disinterested (or both) in engaging in academic activities. ‘Wannabe’ blockchain engineers have two choices:

to start learning by carrying out their own research and establishing their own blockchain project, or

to join a blockchain project as a junior developer — the latter opportunity being very limited. ConsenSys has tried to address this issue, but unfortunately, they lack the determination, the clear plan, and the team that can create something that people will be able to benefit from.

Becoming a blockchain developer is by no means an easy task, it takes extreme ambition and perseverance. A more general programming language skill set needs to be available or developed first, languages like Java, C++, Haskell, OCaml, and Erlang are an excellent stepping stone towards a deeper blockchain tech understanding. They provide the required flexibility of knowledge and skills that are a must in a sphere that is in a constant flux.

On the other hand, decentralized applications are currently primarily developed in Solidity — a three-year-old language whose library is still in its infancy if compared to others like Ruby, Python, or Java. A substantial amount of information and knowledge needs to be generated and shared before blockchain becomes adrift in computer science.

Companies in the crypto-sphere have made some exorbitant commitments in 2017. While many of them involve or rely on nothing less than revolutionary breakthroughs in blockchain technology, what many failed to realize is that there are simply not enough developers with the required R&D and hands-on skills to meet the expectations set by greedy executives and marketing pros. Due to Solidity's resemblance to Python and JavaScript, dApp developers are continually increasing in numbers, yet core blockchain developers are where the real shortage is.

Of course, this scarcity is a breeding ground for low-quality talent, even devs with little blockchain-related knowledge and skills profit from the hype. One can see many self-proclaimed blockchain/smart-contract experts on LinkedIn, however, it can be difficult to become a legitimate expert in a field that has barely existed for 10 years. That is why when it comes to hiring talent in the sector, it is very important to do your homework and do a detailed check of references and past projects. Many devs are riding the demand wave, accumulating wealth, and giving little thought to reputational hazards.

What will help the sphere move forward will be not only open-source research but well-documented, open-source research. Companies trying to improve blockchain protocols by updating existing ones or building new ones from scratch must improve their learning materials as well. Issues need to be well documented, and beginners need to have a clear place to start. Documentation needs to be easily understandable by people with the relevant dev background, and onboarding new developers from the community must be as painless as possible.

What are universities doing about the shortage of blockchain developers problem?

The vast majority of established educational institutions are slow to adapt their curriculum to specialized industry demands such as blockchain technology. Establishing a course in a good university with proper accreditation could take 2-3 years and a decent amount of luck. A great way to push new courses in an accredited way is through SCORM compliance. If you can prepare a SCORM compliant course in the US, each accredited university can immediately implement it and start offering it — we can only hope that this intelligent approach will become more widespread and exportable to other countries.

The current blockchain education space

Despite the low penetration of well-structured educational blockchain programs, there are still a handful of good examples. Princeton and Coursera have partnered to create one of the most comprehensive and standalone starting points for avid learners interested in the sphere. Udemy also features a blockchain course, which is more suitable for a general audience. On the other end of the spectrum, IBM has made developers the primary group of their Hyperledger-focused course, which is free to enroll

in, and MIT's Digital Currency Initiative is also a noteworthy example of how blockchain topics are entering into the academic sphere.

However, it remains to be seen how private blockchain development helps developers enter the "wilder" and much more challenging public blockchain sphere.

Another project that aims to provide a comprehensive solution to the blockchain talent shortage is Academy; they are trying to offer an accredited curriculum and a bootcamp-style solution for experienced developers. The aim is to establish and nurture developer skills and knowledge to a level which is sufficient for the engineering challenges that most blockchain startups are beginning to face.

Software University in Bulgaria also offers a three-part blockchain course in both offline and online options. The course starts with 101 type of information about cryptocurrencies and blockchain technology but then dives into C# and Solidity. Recognizing that blockchain education is needed for sustainable mainstream adoption, æternity blockchain is partnering with SoftUni, providing financial support and lecturers.

Looking ahead

The blockchain hype is at an all-time high, and we are witnessing the birth of numerous revolutionary ideas which, if properly realized, could change the world we live in. In order to avert a mass-extinction similar to the one witnessed after the dot-com boom of the 1990s, the sphere needs to build up a solid blockchain engineering resource. If we fail to develop the backbone of the blockchain behemoth, many promising theories of societal importance will not reach the most important part of their life cycle – real-world deployment.

Every company and established project in the blockchain space should provide resources, help aspiring founders to launch their ideas, build their MVP and most importantly — teach other people, as you learn best when you pass your knowledge to others. The opportunity is up for grabs, start investing in the future of your product by addressing blockchain education today.



The Chief Business Development Officer of æternity, **Nikola Stojanow** has extensive experience working in business development roles in Germany, Eastern Europe, MENA, Asia, and the Pacific. He has developed and consulted on numerous international projects for almost a decade. Having recently been introduced to the unlimited possibilities of blockchain technologies, Nikola also serves as a Business Development Advisor for Adex, the decentralized ad serving network, and a Strategic Advisor for Lockchain, the blockchain-based hotel booking and vacation rental marketplace. Nikola sponsored the first blockchain course at SoftUni in Bulgaria and saw it grow to over 400 attendees while serving as its ambassador and reading numerous lectures on an array of topics in the space. Nikola Stojanow holds a Master of Science Management from Warwick Business School and a Bachelor's Degree in Law from the London Metropolitan University.