CryptoCribs: A Peer-to-Peer Electronic Rental System

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Version 1.0.1

Abstract

A purely peer-to-peer electronic short-term rental system would allow rental payments to be sent directly from one party to another without going through financial and reputational intermediaries like *Airbnb*. We want to provide a peer-to-peer solution to the trust problem inherent with renting out apartments to strangers around the world. In the first stage, we plan to act as the trusted hub by hosting a listing platform *CryptoCribs* that accepts only crypto. This platform will be commission-based and offer a trusted sorting algorithm. Participating nodes, i.e. guests and hosts, are incentivized to join and contribute to the network through activity- and review-based commission rewards. These rewards will half with every $n=10'000$ platform transactions. The platform transaction data will seed a *CryptoCribs* blockchain and smart contract solution where guest and host reviews are stored and nodes can transact without a middle man. To phase in this full disintermediation, *CryptoCribs* will act as gatekeeper and periodically select a fraction of nodes that are given access to the frictionless smart contract solution. The trust blockchain may also allow third party applications to be built on it and leverage the trust ledger for other use cases.

1. Introduction

I have always been fascinated by the idea of staying with locals when traveling. Long before *Airbnb*, I have been sending out emails to complete strangers who had put their places up on *Craigslist*. Of course it was cheaper than staying at a hotel, but the main reason I decided to travel like this were the people it allowed me to meet. There was the documentary filmmaker from Barcelona, the cybersquatter from London and the philosopher from Amsterdam. These hosts have always enriched my travel experience far beyond just local recommendations.

We are launching *CryptoCribs* to improve modern travel even further. By limiting the payment method to Bitcoin and Ether, we aim to build a global community of crypto nomads. This allows travelers and hosts to share not only a flat, but also a passion for crypto, project ideas and maybe even some code. In his intellectual journey that would ultimately lead him to Ethereum, Vitalik Buterin went on a world tour to meet crypto enthusiasts around the world. On the back of his Bitcoin earnings, he was living a peripatetic lifestyle. For a while he stayed with a band of cryptoanarchists in Barcelona, at another point he was living out of the Crypto Castle in San Francisco. This time of travel and his openness to the community allowed his thinking to take in a wide range of perspectives and allowed the Ethereum project to take shape. In that spirit, *CryptoCribs* sees itself as a home for all crypto nomads and as an alternative way of interacting with the crypto community.

While we will act as a centralized platform hub in the beginning, our vision for *CryptoCribs*, as will be outlined in this whitepaper, is to disintermediate ourselves in the long-term. Contrary to the orthodox tech start-up logic, our ambition is not to become a powerful centralized data silo. Rather, we want to build a network of trustworthy nodes and then hand back the value created by the trust network to the members of the community. To achieve this, we aim to marry the best of the openness of *Craigslist*, the trust system of *Airbnb* and the decentralization of the blockchain.

2. Anatomy of flat-sharing intermediation

2.1. Craigslist

In the early years of flat-sharing, I used *Craigslist* to identify hosts and arrange stays with them. While *Craigslist* does a great job in terms of its anonymity, openness and two-click listing user experience, it is a market place with significant information asymmetries. Mainly this is because transactions are not recorded and openly reviewed by the transacting parties. Therefore, repeat market participants cannot build up a reputation on the platform. This market structure can work for transactions that require little trust between nodes, such as selling your old computer screen and then physically exchanging it with the buyer at a the local coffee shop. However, it is ill-suited for more invasive transactions with more security risks, like booking a spare room in a stranger's apartment across the ocean. In the presence of such information asymmetries, a market can degrade to a "market for lemons" in the sense of Akerlof (1970). From my experience, the *Craigslist* short-term sublets section was never cleared out by lemons, but the inventory is clearly not free of fraudulent listings. I personally was never scared away by a few bad apples and developed my personal strategies for weeding them out. However, I can see how it might have put off many potential guests and hosts, thus leading to a market failure. The *Craigslist* network structure is sketched out in Figure 1.
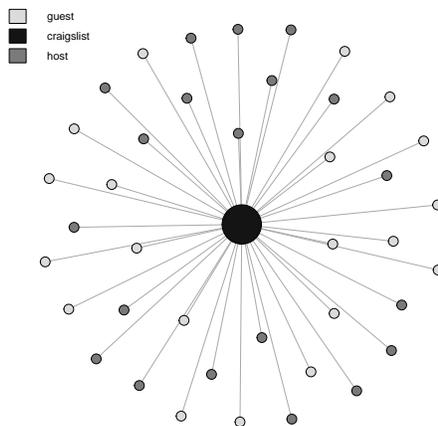

Figure 1: Craigslist network structure

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The nodes in the network represent (i) guests, (ii) hosts and (iii) the *Craigslist* platform. The edges of the network represent (i) a rental listing on *Craigslist* in the case of a host node and (ii) a rental search query to *Craigslist* in the case of a guest node. Notice how there are no transaction links between the guest and host nodes, as past transaction data is not stored on the platform and not made available to other nodes. Every time a guest or host makes use of the platform, it is like he is using it for the first time and he has to re-establish trust with other nodes. The grey shading of the nodes signals the lack of reputation and trust data. In this intermediation structure, the network is unable to "learn" from past transactions and is thus plagued by high transaction costs.

2.2. Airbnb

When *Airbnb* was launched in 2008, it introduced two major intermediation layers:

– financial intermediation; and

– reputational intermediation.

As will be outlined below, both of these product features were crucial for enabling rapid growth of the short-term rental market. However, while delivering substantial value to platform users, *Airbnb* also introduced significant transaction costs compared to the comparatively open and free platform *Craigslist*. The company, which has become a quasi-monopoly in that space, takes commissions as high as 20 percent per transaction. Its most recent valuation of 31bn USD is a good proxy of the value created for individuals, but also the gatekeeper costs imposed on this newly created market.

2.2.1. Financial intermediation

When I traveled with *Craigslist*, I would pay hosts in cash upon arrival. When *Airbnb* came along, online payments became the standard. This worked, because *Airbnb* would act as trusted *escrow agent*. As a guest, you could suddenly pay the escrow agent and the funds were only released to the host when you arrived and confirmed that everything was as expected. As a host, you suddenly had certainty that the guest would actually show up and that you'd get paid for keeping the room free. Brian Chesky, the co-founder of *Airbnb*, recounts the role of payments as follows:

"We launched for South by Southwest. At the time we didn't facilitate payments.[...] We ended up getting two reservations, and I was one of the two reservations. So we weren't that big. And I remember going to Austin. At the time Airbnb was still a little bit like Craigslist. You message, you confirm and you pay in person. So I show up at this guy's house. His name was Tieng-Dan and he's got this traditional Vietnamese dinner ready for me and I look over to the living room and there's this airbed and it's got this little mint on top. And I'm like 'Oh my god, he's taking Airbnb so seriously'. We have this great evening together and at the end of the night he's like 'Oh, by the way, it's going to be 80 dollars'. I did not have cash on me. When you're at an airport, the last thing you think about is cash and it's kind of weird exchanging cash with a stranger in a bedroom that you don't know. So I tell him I'll go to the ATM. And the next day I come back and I forgot to get money and he asks and at this point I don't have any money. And he's about to leave. So at this point the guy starts to be suspicious. He's asking himself 'Did this guy just build a website so that he could freeload off his users'. And I eventually did give him the money, but I remember coming back from South by Southwest. And this was before we even had a business model, it was almost uncool to have a business model in 2008, it was all about getting traffic. **We realized how paying somebody else was the big source of friction. If we could stream on that, we could connect people around the world. So payments was a form of communication for us. And as I think about Airbnb I don't think our core invention was that you could get a home anywhere around the world, I think our core invention was trust and at the center of that trust was the idea of payments"**

While I doubt that *Airbnb* rather than Satoshi or human evolution for that matter should be given credit for inventing trust, Brian rightly points out the value created by inserting *Airbnb* as a payment hub into the network. What he glosses over, is the fact that not only did this make rental transfers easier, but it also gave *Airbnb* control of the monetary flow and enabled them to seamlessly extract a rent from every transaction. One part of the *Airbnb* transaction fee is the price you pay for these escrow services. Guests place

their funds with a high-reputation node, *Airbnb*, which pays low-reputation host nodes only after these nodes have performed their services. This is very similar to the financial intermediation model of Paypal, which has introduced this in a more generalized format to e-commerce and Ebay in particular.

This financial intermediation model makes sense were trust between two nodes cannot be established over time. However, I believe that there is a better, more dynamic way of doing this as will be explained in more detail below.

2.2.2. Reputational intermediation

Financial intermediation was key for *Airbnb's* monetization, but the fuel of its growth engine has always been reputational intermediation. What do I mean by this? I refer to reputational intermediation as the sum of activities performed by the central platform node to lower information asymmetries between contracting nodes in the network. This can involve initial vetting of new nodes, such as identity verification. But even more important that this, it involves the broadcasting of network activity through a centralized transaction and trust ledger. While we have touched on this already above, since trust is endogenous to the financial frictions between guests and hosts, it needs to be analyzed in more detail. I propose that at the core of *Airbnb's* reputational intermediation was the recording of transactions. Remember, transactions on *Craigslist* are not recorded. Every time a node transacts, even a repeat player, it is treated like a new node. Thus, the network does not have the chance to learn from host and guest behavior on previous transactions. *Airbnb* completely changed this by introducing and broadcasting (i) a ledger of previous transactions and (ii) a two-way review record of guests and hosts. Graphically, this can be represented as depicted in Figures 2(a) and 2(b).

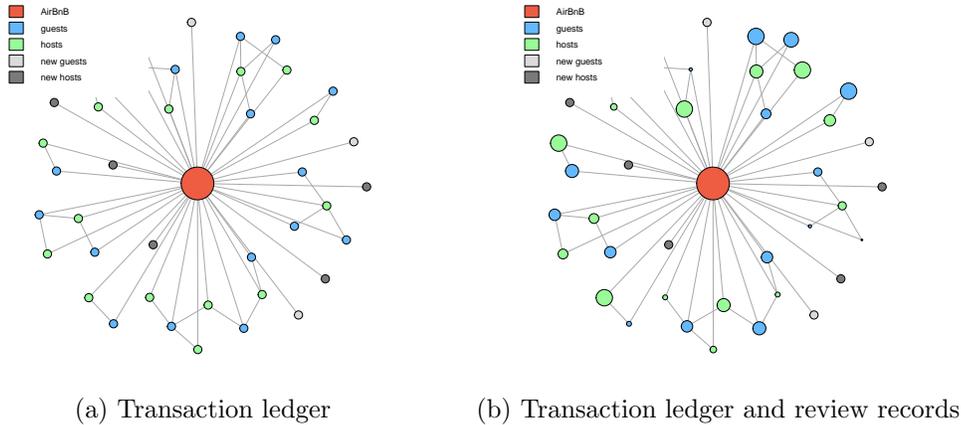| (a) Transaction ledger | (b) Transaction ledger and review records |

Figure 2: Airbnb network structure

Obviously, the initial *Airbnb* network started out just like *Craigslist*: a couple of listings from nodes that cannot necessarily be trusted and no information on prior transactions. But after just a few transactions on the platform, color is added to the network – figuratively and literally. A transaction ledger with valuable data points is broadcasted to the network. As Figure 2(a) shows, the mere transaction ledger already provides value to new nodes entering the network, in particular the guest nodes. I remember scrolling through Craigslist listings, asking myself whether some listings actually existed. With the ledger, guests can see whether hosts have transacted before, giving them at least some confidence that the listings actually exist. However, the transaction data becomes substantially more valuable as the two-way review data is also broadcasted to the network. Figure 2(b) shows the network with information on transactions and review scores. The size of the nodes represents the review score received by the nodes. High-reputation nodes have a larger diameter and a substantially higher probability of transacting in the future. Low-reputation nodes on the other hand are likely to be left out in future transaction rounds.

Clearly, the data provided by the community produces positive network externalities. The network in Figure 2(b), is no longer murky and trustless, rather the transaction and reputation ledger has added color and transparency to the network.

3. Breaking through walled gardens

When you go on *Airbnb* and you see a host with 30 positive reviews, chances are that he or she provides a trustworthy accommodation. This assurance increases further with every positive transaction recorded. In fact, once a host or guest has reached a certain reputation threshold point, there is really no point for the parties to distrust each other anymore. Say there was an option where you could book on *Airbnb* and not pay the (up to 20 percent) commission, but pay directly to the host. I would definitely go for that. Like me, I believe that many parties would choose to rely on the review data and transact directly with high-reputation hosts, especially if you could still get to review them. In this section I want to explain why this isn't happening today, why it should work and how it could be implemented.

3.1. Data silos and censorship

The original purpose of the web and the internet, if you recall, was to build a common neutral network for everyone to participate in, equally and for the betterment of society. So what happened to this initial dream of the world wide web? Well, people soon realized that an easy way to create value on top of this neutral fabric was to build centralized services which gather, trap and monetize information. As a result, the internet, as we know it today is dominated by a number of large data silos. Search engines (e.g. Google), social networks (e.g. Facebook or Twitter), app stores (e.g. Apple) have helped to create powerful companies which provide centralized services and have set up walled gardens.

In that respect, *Airbnb* is no different. While *Airbnb* publicly broadcasts the trust data from its millions of users, it silos the contact information to prevent users from circumventing the platform as a central node. When guests message each other to exchange contact details, *Airbnb* edits out telephone numbers and email addresses. Rather than embracing the fact that its trust system would work autonomously and giving community members the freedom to transact however they wish, *Airbnb* chooses to exert its central platform authority. However, censorship has never worked for long and the company is thereby setting itself up for disruption.

3.2. Recoding the intermediation layer

I believe that the existing centralized intermediation model of *Airbnb* is built for opaque markets with high information asymmetries where reputation and trust cannot be built up over time. However, in a repeat game,

were reputation systems allow users to reduce or even eliminate information asymmetries over time, decentralization has become a possibility. Once the reputation record on the public ledger has tangible value to host and guest nodes alike, this can be weaved into the contractual arrangement. This can obviate the need for financial intermediation, as breach of contractual obligations of high-reputation nodes can be repudiated by the damaged node. In particular by broadcasting the breach to the wider network. Through cryptography and the blockchain, the market structure can be further broken up, as the operation of a centralized transaction and reputation database can be decentralized. Even though the community of the *CryptoCribs* solution we are building may be *byzantine* and not have any reason to trust or depend on each other, the rules that describe the decentralized services behaviour are designed to force participants to act fairly in order to participate at all.

4. The CryptoCribs project

The *CryptoCribs* project has the mission of liberating rental markets, empowering individuals and building a strong community. To achieve this mission, we want to break up the different intermediation layers in a step-by-step process. While *CryptoCribs* plans to act as an intermediary initially, our intention is to progressively disintermediate ourselves. The theoretical basis for this, is laid out below.

4.1. Two-stage Disintermediation

Theorem 1

Reputational intermediation can displace financial intermediation

Let's say a guest (Alice) wants to transact with a host (Bob). To do this, they have to overcome the information asymmetries described above. In the current setting, Alice would send the payment to an escrow agent (C), e.g. *Airbnb*, which keeps these funds in his "safe" and only releases them after the hosting services of Bob have been performed. However, since agent C also keeps a transaction and reputation ledger in its "safe", there is a way for Alice and Bob to transact without funds passing through C's safe. Where Bob is a repeat player and economically depends on a clean record in the ledger of C, the reputation record holds monetary value to him. Therefore

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a write permission on this ledger can be used as an effective replacement of financial intermediation.

Let's assume Alice pays Bob directly in advance without the intermediation of C. In an anonymous exchange setting like that of *Craigslist*, Bob could just take the funds and refuse performance. However, with a centralized reputation ledger, Alice can receive a key to the safe of C. With this key, Alice can open up the safe and change the reputation record of Bob. This write permission on the ledger can be used to coerce Bob to perform his contractual duties. In case of non-performance or breach by Bob, Alice can repudiate through a bad review on the ledger. The write permission is thus a kind of economic "hostage" that Alice takes.

Notice, however, that this hostage only holds a value to Bob if his reputation record is non-zero and if he is planning to transact with other nodes of the network in the future. This is why the disintermediation delineated above only works for mature network structures, in which high-reputation nodes are present. As a result, I initially plan to operate *CryptoCribs* as a centralized platform and establish a curated list of trustworthy, dependable nodes first. These nodes will be enabled to transact freely and without costs on the *CryptoCribs* platform.

> ### Theorem 2
>
> The blockchain can replace the reputational intermediation layer

While I propose to displace financial intermediation with reputational intermediation at the first stage, a blockchain solution could push autonomy of users even further. The blockchain is a powerful transaction-based state machine, which could allow us to disintermediate ourself as a platform. To achieve this, we aim to build a smart contract solution, most likely based on the Ethereum platform. The following description heavily relies on the Ethereum white paper of Gavin Wood and quotes and specifies it for the context of *CryptoCribs*. As we are still building and thinking through the protocol for the decentralized solution, the below sketch may thus be subject to changes over time. For example, one problem I see with the Ethereum smart contracts are their immutability – once deployed to the blockchain they cannot be updated. I expect that the *CryptoCribs* blockchain will need to change its logic over time, we will thus need to find a way to implement upgradeable Ethereum contracts.

The *CryptoCribs* blockchain will begin with a genesis state, which is

seeded by data from our centralized platform service. The blockchain will then incrementally execute transactions between trusted nodes to morph it into some final state. The state will include such information as rental fees, travel dates and guest-host reviews. The *CryptoCribs* transactions represent a valid arc between two states, there exist far more invalid state changes than valid state changes.

Transactions will always involve the recording of both a rental fee that the guest has to pay to the host (on chain or off chain, to allow for different crypto currencies) in exchange for a write permission on the *CryptoCribs* blockchain. Invalid state changes might include actions, such as recording a rental fee account balance without granting a write permission on the reputation ledger.

A valid state transition is one which comes about through a transaction. Transactions are collated into blocks, these blocks are then chained together using a cryptographic hash, ETHash. Blocks function as a trust ledger, recording a series of transactions together with the previous block and an identifier for the final state.

Only transaction and review data of trusted nodes will be included in the genesis state. This limitation to trusted nodes, is due to the required positive economic value of the reputation record that is pledged as economic "hostage"/bond. Consequently, only high-reputation nodes will be given the option to transact directly through the *CryptoCribs* blockchain.

As the *CryptoCribs* blockchain will be integrated into the centralized *CryptoCribs* platform, trusted nodes will be able to transact with the same UI/UX as new platform users. The openness of the platform allows new users to transact outside of the blockchain. This will ensure, that the number of trusted nodes on the *CryptoCribs* blockchain can consistently be increased and is not limited to the seed stage network.

4.2. CryptoCribs network evolution

The *CryptoCribs* network evolution will start out at the initial network state of *Craigslist* depicted in figure 1, where no transaction and review records exist. As transactions occur on the platform, it will transition to a *Airbnb* transaction and review ledger, depicted in figure 2(b). This ledger is produced under the initial centralized platform regime. The network graph in figure 3(a) shows the genesis state, which will seed the *CryptoCribs* blockchain. As the decentralized solution is rolled out, the network state transitions to a much less hierarchical network topology (see figure 3(b)). In

the state transition, a cord cutting will occur, where the central platform node will be displaced. While nodes are still able to view listings over the *CryptoCribs* platform and book through the platform, they can also book directly through the blockchain. Also, third party applications can be build on top of that blockchain, which provide a distinct interface and/or use case for the reputation ledger.
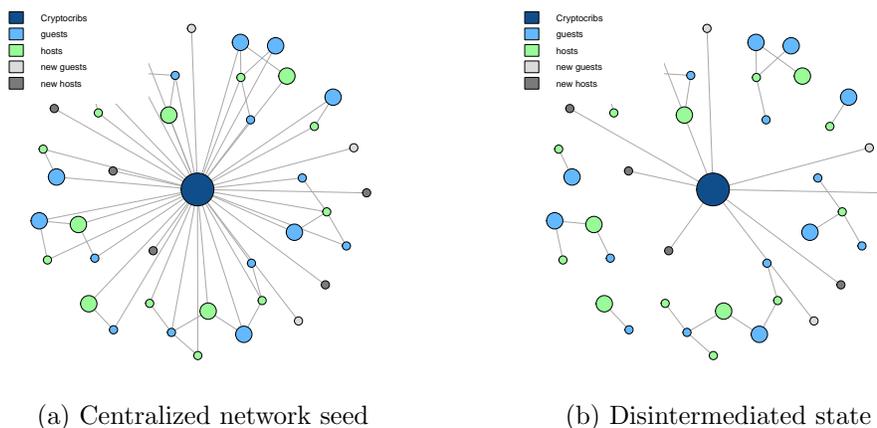

(a) Centralized network seed   (b) Disintermediated state

Figure 3: Cryptocribs network structure

5. The initial product

We are launching *CryptoCribs* as the first vacation rental platform that accepts only crypto currencies (BTC and ETH) as payment. The initial product is a relatively clean and simple solution. However, it already offers all the basic functionalities of the incumbent platforms. Our platform is built on a modern technology stack, including libraries such as Node.js, React, Redux, GraphQL, React Apollo and Express. While the initial solution is centralized, insofar that *CryptoCribs* operates as central payment processing hub, it already disintermediates deeper transaction layers both on the financial and reputational intermediation side.

5.1. Financial Disintermediation

CryptoCribs operates without any bank. It doesn't require services of any payment processor and fully relies on the power of modern crypto currencies.

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This allows it to fully disintermediate the deeper layer payment structure that are standard for the incumbent players.

Airbnb works with roughly 20 different vendors across the board, creating complex and expensive global payments network. In US they use Braintree for payments processing, which charge upwards of 1.9% per transaction. They also use PayPal in the US to process payouts, charging upwards of 3.4%.

Given that *Airbnb* views payments as a "form of communication", it is surprising that the company still refuses to "speak crypto", despite multiple calls from its community. The last time in December 2016, co-founder Brian Chesky asked the *Airbnb* users on Twitter which applications or platforms they would most like to see launched in 2017. As users responded by saying that they want Bitcoin payment integration, he was taken by surprise.

Brian Chesky ✓
@bchesky

Antwort an @sthenc

wow didn't realize this

23:21 - 25. Dez. 2016

CryptoCribs on the other hand is explicitly built to make flat-sharing transactions through crypto possible. In fact, we only accept crypto. While this obviously limits our initial community to those guests and hosts familiar with operating a crypto wallet, we hope that it also allows us to build a community of tech-savvy crypto enthusiasts that share our vision of decentralized living.

5.2. Reputational Disintermediation

With *CryptoCribs* I want to embrace the idea that transaction and review data are a gift by the community to the network and that as such, its value should be returned back to the community. The *CryptoCribs* platform therefore institutes a model whereby every booking and positive review lets guests and host reduce their future service fees.

Airbnb always stresses how much it values community. However, even its most loyal hosts and guests still pay up to 20% in transaction fees. *Airbnb* is intransparent as to how much their actual fees are. The host service fee may range between 3-5%. The guest service fee between 5% and 15% of the reservation subtotal. Given the *de facto* monopoly position of *Airbnb* in the

short-term vacation rental market, fat commissions on every transaction and a decacorn valuation, the company is clearly facing the innovator's dilemma.

CryptoCribs is committed to pay more than lip service to the community idea. We will set out with a total service fee 10%, which is already substantially lower than the average *Airbnb* fee. The service fee will be equally split between hosts and guests. Initially it will thus be 5% for each user. However, with every booking and "five coin" review (hereinafter a "community event"), the service fee of the user is reduced. The reduction follows a rewards schedule that works as follow. For the first *n=10'000* transactions, a reward of 20bps or 0.2% is credited to the user's service fee account. This means that if a user of the initial cohort collects 25 community events, he doesn't pay an service fees going forward. The rewards halve with ever *n=10'000* transaction, until they plateau at 5bps or 0.05%. Through this structure, we aim to give back in-kind to our early supporters and also prepare the platform for a full disintermediation.

6. Conclusion

I have proposed a system for electronic rental transactions without relying on the established trust setting, in particular the centralized *Airbnb* platform regime. I proposed to start with the usual framework of a central trust hub, *CryptoCribs*, through which rental listings and bookings are processed in crypto currencies. This trust hub controls and broadcasts a centralized transaction and review register, but is incomplete without a way to prevent *Airbnb*-style silo building. To solve this, I proposed that the transaction records of *CryptoCribs* could seed the genesis state of a decentralized reputation blockchain. Selected nodes will be enabled to transact through smart contracts without financial and reputation intermediary. While *CryptoCribs* can still host listings, act as escrow agent or be selected as mediator for smart contracts, the reputation blockchain is run decentralized and open for other developers to build reputation-based applications on.