

## Chapter 6

# DEX: A DApp for the Decentralized Marketplace



Chris Dai

It is not an overstatement to say the true value of blockchain technology lies in its ability to use a decentralized model of interaction at the protocol level. This built-in capability is augmenting our Internet, which was built on the ideal of allowing free and unrestricted access to information for all. Instead, the Internet has become the tool for tech giants like Google, Amazon, and Facebook to hold centralized power over its users. Governments have also been able to use this Internet-endowed power to reach to billions of people and manipulate the masses, filter out messages, and limit freedom of speech. Blockchain is the second try at the Internet's idealism, and here we stand in front of this great task. The word "decentralization" seems very utopian, and in the world of a blockchain enthusiast it sounds like a cure for many of the world's problems. But really, what is the value of such decentralization? Is it worth all the effort to break the current centralized organizations and processes into smaller decentralized pieces and micromanage everything at a smaller scale? In our last industrial revolution, value was created through economies of scale. Everyone became a part of a very big machine that output values beyond the sum of the parts. Why are we proposing the opposite now?

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## 1 Why Are We Getting More Centralized as a Whole?

During the 1970s, the Internet in its infancy was designed as a network of computers in which any two computers could send and receive data to each other even if some nodes on the network failed. This was made possible by the protocols invented by computer scientists like Vinton Cerf. His invention of TCP/IP (Transmission Control Protocol/Internet Protocol) allowed for computers in different small networks to talk to each other (Leiner et al. 2003). This decentralized way of sending information came from the needs of the military in the midst of the Cold War, but later it became widely used by researchers around the world to send files to one another. In 1991, the World Wide Web was introduced, and the Internet's function of sending and receiving data expanded to the creation of a "web" of information that anyone connected could see. However, the TCP/IP protocol or the World Wide Web was designed to send and receive information between devices on the network and did not allow for keeping a shared universal ledger that processed user authentication and recorded transactions. Hence, after the introduction of the World Wide Web, businesses sold products, offered services, distributed entertainment contents, and setup social networking sites, but all the authentication and transaction records had to be stored on the service provider's server. Consumers had to trust the platform to keep their personal data safe and not misuse it. From a business point of view, the scalability of the Internet offered businesses great opportunities. The marginal cost of service was so low and the data that platforms could retrieve and aggregate from consumers was so valuable that the so-called Internet business was highly scalable. From this environment, Internet giants like Google, Amazon, Facebook, and Apple (GAFA) have emerged.

In the current centralized model of the Internet, the power balance between consumers and service providers is severely tilted. Scott Galloway, a professor at the New York University Stern School of Business, where he teaches brand strategy and digital marketing, claims that the growth of GAFA poses a threat to society. He believes the tech giants have succeeded in exerting influence over our attention, our loyalty, and our personal information (Galloway 2017). Many people in the tech industry share the same concerns as Galloway; they fear "centralization" of the Internet in the form of GAFA's increasing control on data and IT infrastructure will discourage innovation.

There are many good reasons behind why companies are becoming more centralized. Coase theorized that companies grow bigger when the frictional cost of trading is high. If the internal transaction cost of a company is lower than transacting with an outside company, then it makes economic sense to internalize that transaction (Coase 1937). Companies that are participants of a market economy are themselves command economies if we consider how they operate internally. A company sets annual or quarterly budgets, goals, and key performance indicators and tries to reach them by allocating resources between departments. With the aid of IT, a company can reach a near real-time tracking and transparent view of the market, and, if it can use the Internet to manage its internal structure and execute on the analysis of market data, then a company managed centrally in a hierarchical way can in fact be very

efficient. Information technology helps to lower the frictional cost of trading within the company but does not significantly help the transactions between two unknown parties. Because the frictional cost between two unknown parties is a trust issue, we have traditionally relied on a third party to witness, record, and carry out the transaction. By lowering the external transaction cost, we hope companies do not have to get bigger and bigger to achieve efficiency.

With the use of blockchain, we are now able to run a marketplace in a decentralized way to exchange data and value. By lowering the frictional cost of transaction between unknown parties, we can finally make decentralization cost effective and take away control of the marketplace from central authorities.

## 2 Tokenization at Different Layers of Blockchain

Blockchain is sometimes also called the “chain of values”. Most of the assets that represent value can be represented and owned on the blockchain in the form of “tokens”. Because tokens are issued on different layers of the blockchain, we first need to understand the values that tokens represent at each layer of the blockchain. There are three layers of blockchain that can issue tokens or “tokenize” (see Fig. 1).

### 2.1 Crypto Asset Token and Its Value

Crypto asset tokens can represent anything from a movie ticket to a gallon of oil or one hour someone’s donated time. Because these tokens actually represent assets or values in the physical world, tokenization at this layer is very similar to securitization in the financial world where companies can securitize a real asset or some form of rights for the objective of trading.

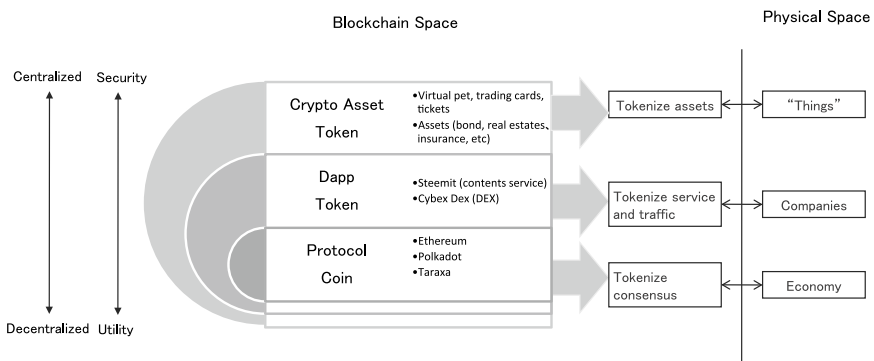


Fig. 1 Tokenization at different layers of blockchain

The issuing of these tokens requires a central entity to maintain the reserves of the actual assets, issue the representing tokens on the blockchain, and guarantee that anyone holding the token can redeem the underlying asset anytime. Blockchain allows for easy issuing of crypto asset tokens and there are many common standards offered by blockchain protocols such as Ethereum, EOS, and so on. The benefit of issuing crypto asset tokens is the ability to create a digital public voucher that cannot be faked and represents some form of rights in regard to the underlying real asset. In addition, the issuing cost for crypto asset tokens is low because no third party or intermediary is needed. The cost only reflects the cost of keeping a record in the public ledger, which is very low. Furthermore, the token or digital voucher itself can contain logic that will be automatically executed and thereby lowers the management cost of the token. For example, if a crypto asset token represents an event ticket, it can be programmed so that after a certain date (e.g., the event date) the token will delete itself. Requirements for approval from multiple parties can also be incorporated (e.g., to transfer the ticket to another person or entity), thus implementing rules for governance.

## ***2.2 Economic Benefit of Tokenization***

The lower issuing cost of crypto asset tokens allows many assets that are non-standard, of low value, or illiquid to be “securitized”, thereby creating a new marketplace for products and services. For example, farmers can issue tokens representing their livestock to collateralize a micro financing loan issued on blockchain. A sports trainer can issue tokens for professional contact time to provide more accurate pricing of services and better scheduling. A restaurant can issue tokens for seats, while a garment manufacturer in China can issue tokens to represent its production capacity of T-shirts so that it will not be affected by the high/low season cycle of manufacturing. The tokenization of various resources in our economy allows values that are internally recognized within a company or organization to be externally valued along with the risk and return associated with it. As such, resource producers can focus on providing the best quality products or services and worry less about market risks and the price of the crypto asset token. To this end, crypto asset tokens allow the externalizing of risk that before could only be absorbed internally. This allows smaller players to survive in a system where larger companies have much bigger advantage in absorbing risks.

The issuing of crypto asset tokens is not just for low-value items but is also beneficial for high-priced items that are illiquid because of their price tag. Artwork, for example, has great aesthetic value that appeals to many. However, because of high prices, most art admirers can only appreciate it at a gallery and are unable to invest in the art market. In addition, because of this illiquidity, the intermediary on the value chain for art items (e.g., art galleries) usually charge a large percentage of the fee, squeezing the artist and the collector. Tokenizing artwork can allow partial ownership of the art, so that anyone can achieve partial ownership of an artwork.

Furthermore, artists can issue crypto asset tokens for their artwork much like crowd funding, providing the buyer with public proof of ownership and better opportunity to resale, while taking away the cost of the intermediary and allowing for higher liquidity.

### ***2.3 Enabling Truly Effective and Fair Exchange***

A new type of marketplace called a decentralized exchange (DEX) is particularly useful because it offers secure peer-to-peer exchange of crypto asset tokens. DEXs offer the perfect marketplace for trading of crypto asset tokens between token holders. A centralized marketplace is a black box that relies on all the participating parties to trust the marketplace to be efficient and fair. However, this is not always the case. FX trading platforms in Japan make profit based on the spread between the buy and sell prices instead of the transaction fee. This means the market operator is also participating as a trading counter party that has the advantage of knowing all the ask and bid prices and can react to the market before all the players. This unfair advantage brings the central exchange operator continuous trading profits. A decentralized exchange on the other hand only has two parties involved; that is, the buyer and the seller. The market itself is only a set of program instructions that makes sure that when a deal is matched between the buyer and seller, no one can back out after both parties have signed. The transaction itself is recorded on the blockchain, so it is easily traced. Instead of trusting a third party to store all the transaction data, it is safer and better to save it on the blockchain so no one can change it later (immutability) and everyone can check it to prove the legitimacy of the trading (transparency) .

By allowing peer-to-peer trading, liquidity is also added to the market where the asset may not have had any physical trading or the legitimacy of ownership was difficult to prove online. In the case of artwork, the number of central exchanges (i.e., auction houses) is limited and only a small group of rich customers/investors are able to participate in the market. These traits make the market very illiquid. However, if artwork tokens are issued in a decentralized exchange, each token can represent partial ownership of the artwork and people who are interested in art can buy and sell tokens and profit from it even if they do not have the money to buy a whole piece of artwork. Because the decentralized exchange is run on automated computer codes, its fee is much lower that of an auction house, and thus can attract more buy and sell transactions. Allowing more players and more transactions in this marketplace allows for liquidity and liquidity creates value. In essence, the crypto asset token value is derived from the value of its underlying asset, plus the liquidity premium generated from the lowering of transaction costs.

## 2.4 *Decentralized Application Tokens and Their Value*

As explained in previous chapters, decentralized applications, or DApps, interact with the blockchain through smart contracts. These applications can also issue their own tokens and these tokens can be traded together with the crypto asset tokens. This is an interesting yet confusing scheme, so it is worth explaining through an example. Cybex is a decentralized exchange DApp that hosts a peer-to-peer marketplace for tokens to be exchanged. Cybex also issues its own token (CYB), which can be used in the Cybex marketplace to pay fees to issue new types of tokens, staking to borrow crypto asset tokens for trading, voting for block producers, and paying for transaction fees for trades in the Cybex marketplace. If the value of a crypto asset token represents the value of the underlying asset + liquidity premium, what is the value of a token issued by a DApp?

First, a DApp token is used as a voucher to receive service in the DApp. Service includes issuing new crypto asset tokens and trading tokens. Because the number of DApp tokens in the system is usually fixed, as more people use the Cybex marketplace to exchange tokens, the demand for CYB increases, and the price of CYB goes up. Hence, the value or price of CYB used as a service voucher depends on the transaction volume and the user traffic on the system.

Second, CYB functions like a share because the token gives the holder voting rights; the holder may have the opportunity to vote on whether additional functions can be implemented in the system, whether a new consensus algorithm needs to be implemented, or which node gets to be the block-producing node, and so on. The holder of CYB is also a shareholder of Cybex in the sense that they have the right to governance of the system and to influence how the ecosystem is run. Ideally, a DApp in its fully decentralized and open-source form will not need a company structure to support it. Also, the ownership of the ecosystem is shared by the participants/token owners. Therefore, it does not make sense to issue equity to its investors because the shares will represent nothing.

A DApp token also represents the shareholding value of the DApp ecosystem. The clear difference from the current company structure is that a DApp native token can be used both as a voucher to the service as well as a shareholding right, but a company like Google will not allow its investors to pay service fees with Google shares. Good or bad, blockchain enables unrelated types of transactions to be encapsulated in a single type of asset with multiple dimensions of value, which increases the difficulty of regulation but allows innovation and value creation through breaking the walls between different business segments. We will see this type of value creation in blockchain in all its layers again and again.

It is also important to note that although tokens created in the purely decentralized application can represent both the service voucher and ownership of the ecosystem or cash flow, there are very few purely decentralized applications in the world. Most DApps created in the near future will be somewhat centralized. Binance token, for example, is built on the trust of the Binance company (one of the largest crypto exchanges in the world) and not blockchain. Therefore, we may need to evaluate

the actual value of DApp tokens on a case by case basis, depending on the level of decentralization and how tokens are used in the DApp.

## ***2.5 Protocol Layer Coin and Its Value***

If we equate the crypto asset token value to representing things in the physical world, and Dapp tokens to value as shares of companies, then what is the value of protocol layer tokens or “coin” as most people call them in the blockchain community? First, the blockchain protocol layer is where the ledger (the public record) and the consensus algorithm (rules about who writes to the ledger) are defined. Within the blockchain network, mining nodes and full nodes provide the infrastructure of the public blockchain that maintains correct recording of transactions to the blockchain and prevents attacks to the blockchain. The function of the protocol in the blockchain world is similar to the function of the constitution and legal system of a nation or economy in the physical world. The codes that run on all nodes in a blockchain are similar to the set of rules we create in our physical world in the form of law. Protocol usage is not free because incentives have to be given to individuals to share their resources as part of the infrastructure. Therefore, every transaction will pay a transaction fee to record a transaction to the ledger. This is similar to tax levied on individuals and companies in the physical world. Coins within the protocol are usually used to pay for transaction fees using the protocol.

What is the value of the coin? This is like asking the value of the US dollar. Many argue that the US dollar is backed by the US Government and therefore has value, but coins issued on blockchain are not backed by anyone and therefore should have no value. Interestingly, on every single US dollar bill, there is one sentence: “IN GOD WE TRUST” (Department of the Treasury website [2011](#)). In some way, it would be more appropriate to say “in the US Government we trust” or “in the Federal Reserve we trust.” This tells us that the value of the US dollar relies more on the individual faith in a collective imagination than on a central authority. Trust of money in a democracy and a market economy comes from the consensus of every member of the society that he or she agrees to exchange value to that money at any time. This trust is a collective trust, and this trust is realized on the blockchain using coins and tokens. In essence, coin is a medium of exchange but also represents the trust of the participants in the ecosystem.

Unlike the real world, where individuals may not be able to choose their country or economy, choosing a blockchain is much easier and simply requires the purchase of tokens or coins to transact with others. This kind of liquidity allows for competition between blockchain protocols, and, ultimately, should lead to the improvement of blockchain protocol. At the protocol layer, there should be no real owner of the protocol because it is an infrastructure. Protocol is more decentralized than the DApp, which limits the development team’s monetization method to mainly token sale.

### 3 What Is a DEX?

So far, we have explained how blockchain tokens can be used to represent and record value data and build new business models that open up that data to all participants in the system. However, if only token issuing on the blockchain uses the decentralized model while exchange of tokens is done centrally, then the full potential of the blockchain decentralized model cannot be achieved.

When Adam Smith proposed the concept of the invisible hand, he still envisioned the marketplace itself to be run by a central entity (Smith 1776). Today we see many marketplaces in the world: marketplaces for consumer products like Amazon or securities markets like the New York Stock Exchange or the Tokyo Stock Exchange, and commodity exchange markets like the Chicago Mercantile Exchange, and so on. These marketplaces together create the backbone of our market economy, channeling and optimizing the flow of money to the right industry and assets. However, most of these exchanges are not as efficient as we might think. There are many intermediaries between the buyer and seller and some transactions have very complicated and manual settlement processes that take many days to clear. With blockchain, a new type of Dapp<sup>1</sup> called “DEX” (as shorthand for “decentralized exchange”) is about to change the way we trade with each other.

A decentralized exchange on the blockchain has the following characteristics:

- Allows peer-to-peer exchange of token/crypto assets without an intermediary party.
- Each participant controls his/her own asset (private key).
- All transactions are written on the blockchain and are transparent for the public to see.
- All transactions after confirmation are immutable.

#### 3.1 Key Technical Core of a DEX

In the previous section, we argued for the benefit of DEX and considered the types of asset that can be traded on a DEX. It is also worthwhile to take a closer look at the technical features of a DEX and how it is implemented. The core of a DEX is a feature called “atomic swap”, which is code on the blockchain that allows two parties to exchange tokens/crypto assets without involving an intermediary party, and avoids one party defaulting on the transaction, which would damage the counter party. In a DEX, unlike a centralized exchange, participants manage their own crypto assets in their own wallet. When there is an exchange between two parties, the exchange occurs directly between the two wallets instead of going through a trusted third party. This direct exchange process is called atomic swap. There are many ways to implement atomic swap and Fig. 2 shows the method proposed by Charlie Lee, the founder of Litecoin.

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<sup>1</sup>An application run by many users on a decentralized network with trustless protocols.  
[https://en.wikipedia.org/wiki/Decentralized\\_application](https://en.wikipedia.org/wiki/Decentralized_application).



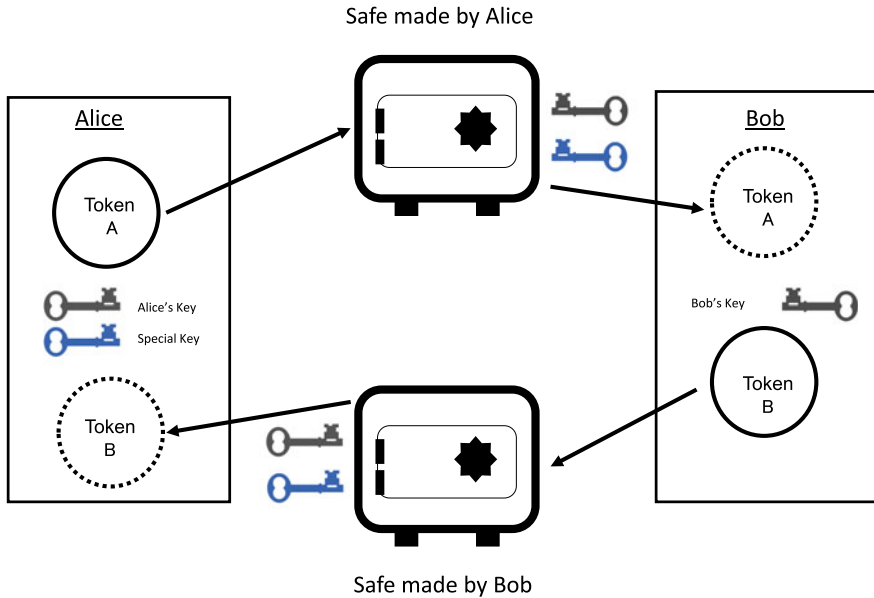


Fig. 2 An example of atomic swap

Figure 2 shows a case with two participants, Alice and Bob, who want to swap tokens on two different blockchains with each other. Alice holds token A of blockchain A and Bob holds token B of blockchain B. First, Alice and Bob agree on an exchange rate of 1 A token for 1 B token. Negotiation of the exchange price occurs on a buy/sell board or a chat board. After the exchange rate is agreed, Alice creates a digital safe on chain A that can be opened by Bob's key and a special key created by Alice and unknown to Bob. Alice puts 1 A token in the safe and sends safe information to Bob, sharing the specifications of the lock for the special key without sharing the key. Bob then also creates a digital safe on chain B and puts 1 B token in the safe. Bob's safe can only be opened by Alice's key and the special key used together, but when the special key is used by Alice to open the safe on chain B, the special key will be revealed to Bob. Similarly, Bob uses his own key and the revealed special key to open the safe box on chain A and the transaction is completed. The locks on both safe boxes have a time limit, and if Alice does not open the safe box on chain B, or Bob does not create the safe box on chain B and send the information to Alice, then the tokens in the safe will be returned to the original owners without causing loss to either party. In this case, after Alice opens the safe on chain B, there is no turning back and the transaction will be carried out. This is why the process is called "atomic swap", because it follows the original concept that the atom is not divisible, and this process is designed so that transaction between two chains can be whole and not divisible after both parties commit. Atomic swap provides predictable and transparent exchange of tokens on different blockchains on the basis of code and

not based on the trust of a third party. In the next section, we examine its implications and impact through actual cases.

### ***3.2 Implication of DEX: Revolution Brought by the Ability to Issue, Trade, and Record Crypto Assets***

While the merit of the atomic swap is very clear for trading crypto assets, the function of the DEX reaches far beyond that of an exchange. Compared to a centralized exchange, which can only be used for exchange of crypto assets, a DEX can use its chain to issue new crypto assets, trade that crypto asset, and record business transactions related to the crypto asset. We have no centralized platform that can do all three together. Binance offers a central platform to trade crypto assets, but, because it is centralized and does not use blockchain to run its exchange, it has to manually issue new crypto assets in its exchange. Similarly, a DApp that uses crypto assets cannot record transactions on Binance's central trading platform. What is the benefit of doing all three processes of issuing, trading, and recording transactions on a single blockchain? If all activities related to a single crypto asset are recorded on the same blockchain, then users and investors can get full view of usage/transaction and transaction records of the issuing party. This creates more transparency and adds credibility to the crypto assets. With transparency around transaction data, a DEX can truly become an ecosystem to host services and allow liquidity to crypto assets backed with goods and services.

The value of a DEX is clearly demonstrated in RECIKA's<sup>2</sup> consumer data marketplace project that aims to democratize the trading of consumer purchasing data. By using a DEX as the core system, RECIKA allows individuals to upload the scan of their purchasing receipts to receive tokens while businesses that want to access uploaded consumer data can pay tokens to retrieve the data. In the current business model, consumer purchasing data are stored in retailers' databases but retailers are not incentivized to share this data. It is difficult for smaller manufacturers and startups to access such consumer purchasing data. By acknowledging consumers' ownership rights to their consumption data and attaining their consent to share that data, such data can be circulated between consumers, retailers, and manufacturers. All the data transactions are recorded on the DEX blockchain to allow for transparency in the system. Any participant can check how much data is being uploaded and how much data is exchanged. In addition, manufacturers can issue their own point reward system by issuing their own tokens to any consumer that has uploaded a receipt containing the manufacturer's product. Issued points (tokens) of all the manufacturers can also be traded on the DEX, so consumers can convert points from different manufacturers to the desired manufacturer when needed. All this can be achieved in the centralized system, but generally the consumer and/or manufacturer do not trust their data and points to an intermediary. Rather than trusting a third party

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<sup>2</sup>For more information on RECIKA, please visit [www.recika.jp](http://www.recika.jp).

that may leak consumers' privacy data or abuse the power they hold over consumers and manufacturers, a decentralized ecosystem will receive more support from the different parties involved.

Another use case built on top of DEX is the issuing of tickets. A DEX allows for applications to issue fungible<sup>3</sup> and non-fungible<sup>4</sup> tokens and peer-to-peer transfer and trade of those tokens. These functions are very convenient for event organizers and ticket issuers. In Japan, most event tickets are not digitized and many small to medium-sized event organizers still use fax to confirm reservations. The big ticket platforms charge a significant fee that small to medium-sized companies cannot afford. By issuing tickets as tokens on the DEX chain, the cost of issuing tickets is lowered but it also allows for a secondary market where trading of the tickets is possible, and the legitimacy of the ticket is verifiable. The ticket token issued on the blockchain becomes the digital identification that attendees of the event can show at the event reception counter.

### 3.3 Challenges for DEX

While the trading of data and tickets on DEX may seem benign to financial regulatory bodies, trading of crypto currencies and other financial securities on a peer-to-peer basis poses serious concerns in the area of money laundering and the funding of crime and terrorism. This concern is not just for DEX but for crypto currency as a whole. Because of the lack of central authentication, many DEXs do not require "know your customer" (KYC) to function and do not have a clear entity of responsibility for liaising with government regulatory bodies. For DEX to be used more widely, it is true that functions such as KYC and accountability need to be built into the code, which may result in more centralized operation of a DEX. DEX also offers the opportunity for regulatory agencies and society as a whole to monitor for suspicious transactions and operations in a drastically different paradigm. Blockchain offers an ocean of global financial transaction data that is transparent to all. It allows anyone to retrieve and analyze data, which is very difficult to achieve in the current financial industry where every bank hides transactions in highly secure servers. Utilizing AI technology with this big data allows regulation technology to be developed that can find, monitor, and trace illicit activity on the blockchain with very high efficiency.

Aside from the regulatory challenges, the current DEX user base is not growing fast despite its obvious benefits because of the low performance of the underlying blockchain technology. The transaction speed of a centralized exchange is 100× or 1000× that of the current best performing DEX, giving the user a much better

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<sup>3</sup>Fungibility is the property of a good or a commodity that has individual units that are essentially interchangeable.

<sup>4</sup>A non-fungible token (NFT) is a special type of cryptographic token that represents something unique; thus, NFTs are not interchangeable. This is in contrast to crypto currencies like Bitcoin, and many network or utility tokens that are fungible in nature.

experience. There is much work to be done to solve the scalability issue of blockchain and hopefully it will bring the proliferation of DEX.

Ultimately, our biggest challenge is ourselves. We are too comfortable with relying on centralized authority to manage what is most valuable and dearest to us, may it be our personal data or asset possessions. In this process, we are in danger of losing not only our privacy but also being taken advantage of by central authorities that are able to use our data to influence our behaviors. Blockchain-enabled DEX puts everyone standing at the crossroad again, providing us with the option to choose and to be in control once more.

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