KyberNetwork

A trustless decentralized exchange and payment service

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Abstract. We design and build KyberNetwork, an on-chain protocol which allows instant exchange and conversion of digital assets (e.g. crypto tokens) and cryptocurrencies (e.g. Ether, Bitcoin, ZCash) with high liquidity. KyberNetwork will be the first system that implements several ideal operating properties of an exchange including trustless, decentralized execution, instant trade and high liquidity. Besides serving as an exchange, KyberNetwork also provides payment APIs that will allow Ethereum accounts to easily receive payments from any crypto tokens. As an example, any merchant can now use KyberNetwork APIs to allow users to pay in any crypto tokens, but the merchant will receive payments in Ether (ETH) or other preferred tokens.
Although running on the Ethereum network, KyberNetwork's roadmap includes supporting cross-chain trades between different cryptocurrencies using relays and future protocols like Polkadot and Cosmos. Ethereum accounts will be able to safely receive payment from Bitcoin, ZCash and other cryptocurrencies via our payment APIs, through this trustless payment service. Derivatives will be introduced to mitigate the exposure to the risk of volatilities for the users of KyberNetwork Crystals (KNC) and selected cryptocurrencies. This will allow users to participate in the price movements synthetically.

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1. Introduction

Emerging cryptocurrencies such as Bitcoin, Ethereum and others have been gaining tractions of late because they allow users to transact, manage their digital assets in a decentralized and trustless model without relying on a third party. More interestingly, Ethereum network, with its turing complete scripting language and trustless smart contracts, makes its easier for people to issue and digitalize their own crypto tokens which either represents some real-world asset (e.g. Digix Gold token) or has values in some platform (GolemNetwork token, Gnosis token, Augur token and so on). To date, the total market capitalization of the most popular cryptocurrency assets is 72 Billion USD[1]. This total market cap has tripled in the last 5 months and is still growing.

1.1. Motivation

1.1.1. Risk of centralization

As the Blockchain market grows and more crypto assets are being introduced, the need to convert and exchange between crypto tokens is ever increasing. The trade volume between, for example, ETH and Bitcoin is worth hundreds of million of dollars per day on major exchanges. The total trade volume between ETH and other crypto tokens on its network, most of which are less than 2 years-old, is also in the order of millions of dollars. However, despite the decentralized and trustless natures of cryptocurrencies and crypto tokens, most of the trades happening on centralized exchanges are vulnerable to internal fraud and external hacking. This is an ongoing concern and a number of hacking incidents has been reported at various exchanges[2] affecting thousands of users and loss of hundreds of million of dollars.

1.1.2. Lack of instant exchanges

Existing exchanges, including centralized and decentralized ones, often require user to wait for several minutes before allowing them to withdraw their funds.

1.1.3. Problem of existing decentralized exchanges

The quests to build decentralized exchanges have been initiated by several parties on the Ethereum network[3]. Although these parties build decentralized and trustless exchanges, they are still vulnerable to external manipulation since there is a delay when an order is created and when it is accepted in a block (read more here).

[1] https://coinmarketcap.com/charts/
[2] For example, MtGox, Bitfinex, Shapeshift.
[3] See 0xProject, OasisIndex and EtherDelta.

There are other possible reasons that existing decentralized exchanges are not as popular as expected despite having better security features. These exchanges keep an orderbook of users on the chain. As a result, adjustment or cancellation of bid orders can be expensive to regular users. Repeated revisions of orders will compound the issues as the cost will escalate until a match between buy and sell order is found.

Some exchanges[4] hope to resolve this issue by making the price discovery and negotiation process done offline via intermediate parties. A trade is done on-chain only after the two parties have agreed on the rate. This raises the issues of trust in the role of the intermediate party in finding the best counterparty for the trade. We also note that no-fees orders are susceptible to adversarial sybil or denial-of-service attacks.

1.1.4. The problem of having many digital assets

As the number of ICOs increases, so does the introduction of new crypto tokens. It is logical to assume that investors will acquire a variety of desired crypto tokens as part of their investment strategy. The convertibility of one crypto token to another represents a new challenge for both investors and operators alike. For example, it may be a challenge for any party to allow an already deployed contract to accept new crypto tokens as a form of payment.

It also introduces more room for implementation bugs and security flaws. As an example, recently, in the DAO Token ICO, there was a major bug that distributed more tokens to SNGLS contributors than to ETH contributors, although they contributed the same amount. Thus, there is a need to simplify the payment procedure for both token holders, merchants and users in the network.

1.2. The KyberNetwork

We introduce KyberNetwork, an on-chain decentralized exchange providing several useful applications, including building a practical exchange and providing payment APIs for merchants and users to instantly convert tokens effortlessly and “trustlessly”. There is no orderbook. Users will know the conversion rate before sending the transaction and receive the corresponding amount. Users don’t pay any extra fees (other than the gas fees for the transaction). KyberNetwork benefits through pricing a reasonable spread in the conversion rate.

Our users can also send their existing token A, by converting to a different type of token B and sending it to another user, who only accepts payment in B all in one transaction. More interestingly, KyberNetwork introduces a new standard contract wallet to allow existing contracts, which only accepts few tokens, to receive payments from any future tokens without

[4] Swap.tech and 0xproject

any modification to the contract code. This allows contracts or merchants to access to a wider class of users, receives payments and contributions in any tokens that KyberNetwork supports.

KyberNetwork's design has several novel constructions to support all these applications.

- Instead of maintaining a global order book, we maintain a reserve warehouse which holds an appropriate amount of crypto tokens for purposes of maintaining exchange liquidity. The reserve is directly controlled by the Kyber contract, and the contract has a conversion rate for each exchange pair of tokens by fetching from all the reserves. The rates are frequently updated by the reserve managers, and Kyber contract will select the best rate for the users. When a request to convert from token A to token B arrives, the Kyber contract checks if the correct amount of token A has been credited to the contract, then sends the corresponding amount of token B to the sender's specified address. The amount of token A, after the fees, is credited to the reserve that provides the token B.
- We introduce a new standard contract wallet to enable some of our interesting applications. Specifically, our new standard contract wallet allows the Kyber contract to send a user's newly converted tokens to his/ her destination address on the user's behalf. The destination address will receive the converted tokens as if the tokens were sent from the sender, not the Kyber contract.
- Our long-term plan also includes employing future features of the EVM language to build an efficient ZCash-Relay on Ethereum. A ZCash-Relay on Ethereum will allow us to support cross-chain trades between ETH and ZEC. We also leverage future platforms like Polkadot and Cosmos to enable more cross-chain trading and payments.
- The Kyber contract is designed with extensibility-focus which has well modularized components. Specifically, we allow dynamically adding any new tokens or delisting existing tokens. Thus, we are able to work with any tokens or digital assets in the future.

2. KyberNetwork's Design

2.1. Actors in the KyberNetwork

There are 5 roles for the actors in the network:

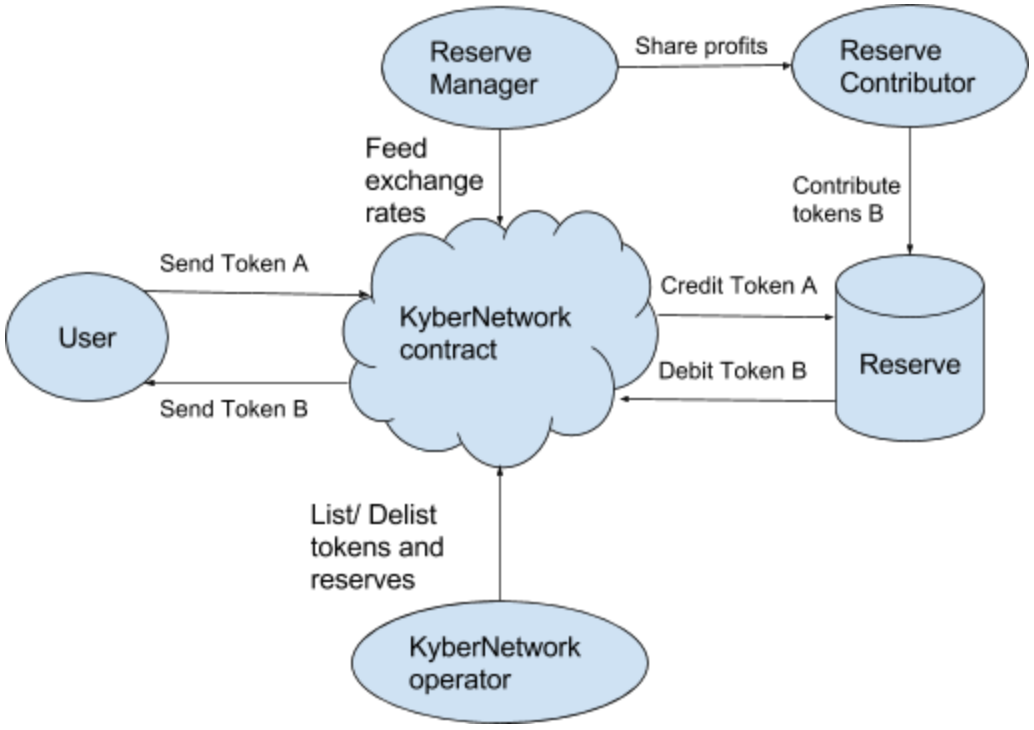
1. Users who send and receive token[5] to and from the network. Users in KyberNetwork includes individual users, smart contract accounts and merchants.
2. A reserve entity(ies) provides liquidity to the platform. This can be our own reserve or other third party reserves that are registered by other market makers. Reserves can also be classified into public and private reserves which do and do not take contributions from the public.
3. Reserve contributors who provide capital to the reserve entity and share the platform profit. This actor only exists in public reserves which accept contributions from public to build up the reserve.

[5] For the rest of this paper a token also refers to the Ether currency.

4. Reserve manager who maintains the reserve, determines exchange rates and feeds the rates to the KyberNetwork.
5. KyberNetwork operator who is responsible to add and remove reserve entities, list/delist pairs of tokens in the network. Initially the Kyber team will act as the KyberNetwork operators to bootstrap the platform in the early phases. Later on, a proper decentralized governance will be set up to take over the task.

Each of the actors interacts with the smart contract independently in a different way. The users send and receive tokens within a single transaction, without waiting for any response from the reserve or the KyberNetwork operator. The KyberNetwork operator is responsible for adding and removing reserves, while the reserve manager determines and feeds the exchange rates to the contract for a fixed period (several seconds basis). The main contract relies on the reserve entity to guarantee high liquidity.

The diagram below illustrates the interaction of each of the actors.



2.2. Dynamic Reserve Pool

KyberNetwork guarantees high liquidity by leveraging the existing reserves in the network. Different reserves are directly managed by different reserve managers, which may and may not be associated to KyberNetwork operator. KyberNetwork allows multiple reserves to co-exist to enable better prices (by eliminating monopoly of reserve), guarantee better liquidity (by utilising

other sources). Furthermore, allowing different people, apart from KyberNetwork operator, to manage their own reserves permits KyberNetwork to support low-trading-volume tokens by off-loading the management efforts of those tokens to corresponding reserve managers. Thus, different parties who wish to take the risk of trading/ converting low-trading-volume tokens can create their own reserve of those tokens and register with KyberNetwork. Note that KyberNetwork does not hold any funds of the reserves that register with it. Their funds are stored on their reserve contracts which will follow KyberNetwork ground principles.

When a trade/ conversion request arrives, KyberNetwork will fetch the conversion rates from all reserves that can process the request. KyberNetwork then selects the best rates and executes the request. We guarantee that both the reserves and the users are safe, namely we do not keep any party's funds and all transactions are atomic.

We note that when we launch KyberNetwork, it is likely to have only a single reserve provided by us in the network. This reserve will be the main source of liquidity for the system before other reserves are registered.

Why other reserves should join KyberNetwork? KyberNetwork creates a platform for reserve managers to monetize their otherwise idle assets. By serving trade requests from users, reserves earn profit from the spread, which they can decide on their own. Of course the reserves can always do the trading without joining KyberNetwork, however they will get higher volume due to network effects in KyberNetwork. We will bring more users to KyberNetwork by having collaborations with wallet providers and other token projects.
In addition, KyberNetwork also provides a reserve dashboard software to help reserve managers manage their reserve portfolio. The reserve dashboard will include standard and popular trading algorithms/ strategies to allow reserve managers to automatically make prices and rebalance their portfolio. Our reserve dashboard is flexible enough that reserve managers can always implement and deploy their own strategies when and where they see fit.

How to keep the reserves safe? The security of reserves becomes a major concern in KyberNetwork, especially for public reserves that take contributions from other members in the network. One of the primary concerns is that a bad/unethical reserve manager may quote and trade bad prices to him/herself to drain all coins from the reserve.
Let us categorize the reserves into two types: (1) private reserves which do not accept contributions and (2) *public* reserves which take external contributions and share profits with contributors. Whilst still a valid concern, if reserve managers of private reserves follow good security practices, the risk exposure of private reserves can be confined to an acceptable range, especially since the reserves are handled locally and other parties cannot interfere without permission. On the other hand, public reserves are subject to greater risk exposure due to its open nature. To mitigate the security risks of public reserves, we will employ a transparent fund management model, for example MelonFund (developed by MelonPort), so that contributors of the reserve can track all trading activities done by reserve managers. On top of that, we also plan to introduce restrictions to protect open reserves. For example, the funds of the reserves

can only be transferred to predefined addresses in the contracts, such as the reserve contract itself, and other exchanges that the reserves interact with. Hence, the risk of unwarranted extraction of funds out of the system is removed. Also, to prevent reserve managers from deliberately setting up false and unreasonable exchange rates, e.g. one million Golem Network Token (GNT) per Ether when the spot rate is only five hundred GNT to one Ether, just so that the manager can buy GNTs at a cheap price, we employ both on-chain mechanisms (e.g., prevent unreasonable changes in price without special authorization) and by off-chain mechanisms. For example, a background monitor that will halt transactions when the system detects dubious activities that undermine the integrity of the network can watch and flag out suspicious behaviours from any reserve manager in the network.

2.3. Main System Components

KyberNetwork consists of the following major components in its system.

- Smart contracts: KyberNetwork contains several contracts, including the main contract which serves as the main entrance to the system for users and reserve managers. We also have different contracts to maintain the reserves, and a contract wallet which provides convenient interface to all features that Kyber supports.
- User's wallet: Wallet apps with friendly interfaces to support users. Integrations with existing wallet apps like Status, Token, Metamask and so on will help improve the adoption of KyberNetwork.
- Reserve manager portal: aids the management of the reserve by displaying their performance, network stats, supporting different strategies and algorithms to make prices/ rebalance. Reserve managers interact with the network (or the Kyber contract) via this portal.
- Operator dashboard: Helps KyberNetwork operator manage the entire system. Operator can add and remove new reserves, change network parameters via this dashboard.

A minimum-viable-product has been released in August 2017. The readers can find more details in our release blog post [6].

2.4. KyberNetwork APIs

KyberNetwork supports different API commands for users, reserve and reserve contributors.

2.4.1. User API

User API can be called by any Ethereum account, including normal account and contract ones.

Transfer(amount, source tokens, destination token name, destination address)
Transfer function converts **amount** of source tokens (token A) to destination tokens (token B) and sends type B tokens to destination address. For example, users can call

[6] https://blog.kyber.network/kybernetwork-mvp-release-e8440a79346f

Transfer(100, "DGD", "Melon", "0xb794f5ea0ba39494ce839613fffba74279579268"*)*
to convert 100 DigixDao tokens to Melonport tokens and transfer all converted Melonport tokens to "0xb794f5ea0ba39494ce839613fffba74279579268".

GetExchangeRate(token A, token B)
Returns the conversion rate between token A and token B. In the future we can support different exchange rates for different trade volumes.

2.4.2. Reserve Contributor API

Reserve Contributor APIs can be called by any account in the Ethereum network, though some API only works if the account already contributed. There will be two different reserve types in KyberNetwork: private ones which do not take public contributions and public ones which allow others to contribute funds. The APIs for public reserves highly resemble ones from MelonFund (decentralized hedge fund platform built by MelonPort). Here we list the main ones.

ContributeReserve(token type, amount)
Contribute some amount of tokens of a certain token type to the reserve. For every contribution, the contributor will receive some amount of reserve tokens/ shares to represent their contribution to the platform. We refer the readers to Melonport's greenpaper for more technical details.

WithdrawProfits()
Profits are distributed proportionally to the contributions of the contributors. The exact formula to distribute the platform profits will depend on the implementation of the reserve.

WithdrawContribution(KNC amount, token type)
An existing contributor can withdraw their contribution from the reserve. The contributor can specify in which token type that he wishes to receive for his withdrawn contribution, we do the conversion in the background.

2.4.3. Reserve Manager API

SetRate(token A , token B, rate)
To set a conversion rate between an existing pair of token A and token B. In the real deployment, this API will be replaced by a different API which updates the rates of all existing pairs in one transaction. The purpose of batch-update is mainly to reduce the gas cost.

2.4.4. KyberNetwork Operator API

ListPair (token A, token B, initial rate)
To introduce a new pair of tokens that KyberNetwork supports.

DelistPair (token A, token B)
To stop accepting trade between a pair of tokens.

AddReserve (reserveAddress)
Add a new reserve to the network. The reserve is managed by its own manager.

RemoveReserve (reserveAddress)
Remove an existing reserve from KyberNetwork. The removal is due to low liquidity, bad price and other reasons.

2.5. Support trustless trading cross-chain

Chain relays, e.g. BTCRlay, enables communication between different blockchains. The launches of protocols like Polkadot and Cosmos will make cross-chain interactions even easier. KyberNetwork will leverage these technologies to allow Ethereum accounts to receive payments from different cryptocurrencies.

3. System Properties

3.1. Trustless and secure

The KyberNetwork operator does not hold the tokens of the users. Hence, by design, user's tokens are secured from theft losses. Users need not trust the intentions of the reserve entity and the KNC token holders, as the integrity of the operator is enforced/ensured by the smart contract.

3.2. Instant trade

An exchange or convert request is executed immediately within a single transaction. Users get their exchanged token at the exact moment they transferred their original token. No deposit or confirmation or waiting time is needed. This efficient and user friendly feature distinguishes KyberNetwork from most other existing and future exchanges.

3.3. On-chain exchange

The exchange runs on chain and is accessible for all accounts, including normal accounts and smart contracts. That allows smart contracts to directly interact with the exchange without a third party intervention to receive funds/ payments from different tokens that they do not support

originally. This feature enables usKyberNetwork to be an on-chain proxy payment platform for all accounts, including normal accounts and smart contracts.

3.4. Compatibility

KyberNetwork does not require any modification in the underlying protocol of Ethereum and existing smart contracts to function. Our payment API can communicate with existing contracts without any change on their side.

That said, we also introduce a new contract wallet that holds all user Ether and tokens. The wallet allows the user to pay with token A to a contract that expects token B, where the conversion from A to B is seamlessly done by the KyberNetwork. The receiver will receive the payment as if it was sent by the original user.

3.5. Comparison to existing systems

We compare KyberNetwork to existing systems in the table below. We left out Bancor intentionally as they claim (from our private conversation) to be a platform that focus on community tokens, rather than general purpose exchange.

Exchange	Trading Cost [7]	Trustless	Instant Trades	On-chain	Guaranteed Liquidity	SecureAgainst Attacks
Kraken/Poloniex	Low	No	No	No	Yes	No
Shapeshift	Low	No	Yes	No	Yes	No
Coinbase	Low	No	Yes	No	Yes	No
EtherDelta Oasis Index	High	Yes	No	Yes	No	Yes
Swap.tech 0xProject	Low Low	Somewh-at[8]	No	Hybrid	No	Not sure[9]
KyberNetwork	Low	Yes	Yes	Yes	Yes	Yes

[7] Cost to execute a trade, apart from the trading fees.
[8] Users need to trust the relays to match them the best counterparties
[9] Attackers can create fake orders without any cost. No guarantee that a trade can be settled.

4. Applications

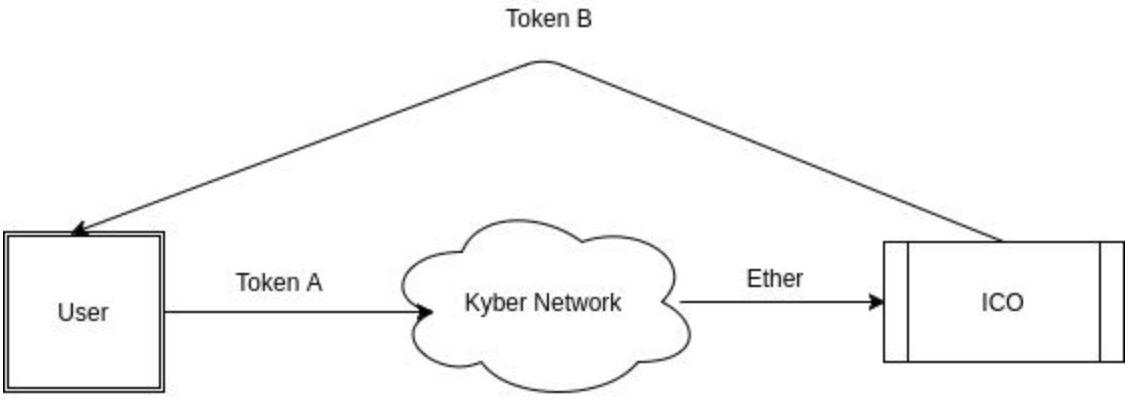
4.1. Instant and secure exchange

First and foremost, KyberNetwork is an exchange. Unlike most exchanges, however, KyberNetwork performs trade requests instantly. Moreover, KyberNetwork does not hold users' tokens, thus any theft or loss of tokens is prevented by design.

This contrasts sharply to most exchanges where confirmation time of several minutes is typically needed. Any malfunction during that period could potentially result in inconvenience or in the worst case scenario, loss of funds.

4.2. Generic payment APIs with any token

Conducting an exchange over a smart contract allows user to pay for any service or product with any crypto token they prefer. The contract will provide instant conversion to Ether and securely pay on behalf of the user to any contract he wishes. The figure below describes how a user could participate in an ICO that accepts only Ether with any token. The entire process occurs within a single transaction, and the KyberNetwork never has a possession on the user tokens (neither token A nor token B).



4.3. Trusted on-chain source for rate quotes

KyberNetwork exchange rates are visible to other smart contracts. Hence, it enables the implementation of advanced financial instruments such as swap contracts. The quotes provided by KyberNetwork are secure as they reflect the real rates which are being used to trade between pairs of tokens.

4.4. Mitigate the risks of price fluctuations

Due to the illiquidity of crypto assets, the exchange rates often seem too volatile due to irregular demand and supply. This issue is aggravated further due to lack of parties that are willing to warehouse crypto-assets. The lack of options means now that it is almost impossible for users of crypto assets to hedge themselves for future requirements. The KyberNetwork will be addressing this challenge by introducing derivatives in the forms of forwards and options to provide more alternatives to users.

4.5. Forwards

A forward is a contract whereby parties agree to trade an asset at a later date at a price specified in the present. One of the common problems as ICOs become mainstream is the need for some users to convert between tokens, such as from Melon to ETH, in preparation to participate in an upcoming ICO. The user could either acquire ETH at current market rate or commit to a forward contract to negate the risk of the price fluctuations in the ETH as an viable alternative.

4.6. Options

Options contracts allow users to hedge against adverse price movement for a fee called premium. A call option gives the owner of the contract the right to purchase the crypto asset at an agreed price. A put option is an opposite. The premium is calculated using the implied volatility of the underlying crypto asset.
The user of crypto assets that need to prepare for a future purchase or sale commitments can pay a premium to buy a call or put option. As an example, holders of iced tokens are able to write call options to earn premiums while forgoing the upside of the price.

5. Road map

The road map of KyberNetwork includes several phases.

5.1. Phase 0: Testnet deployment

Est. delivery: August 2017
Develop an MVP version of our platform, including the KyberNetwork wallet, the main KyberNetwork contract and our reserve dashboard. The purpose of this phase is to create a basic and functional version of KyberNetwork with all the main functionalities and applications. The MVP will be released publicly, and the related contracts will be deployed and tested on the Ethereum testnet.

5.2. Phase 1: Basic mainnet deployment

Est. delivery: Q1 2018

We deploy the first version of KyberNetwork on the mainnet. We start off with supporting trades and proxy payments between any tokens to and from Ether. It is likely that our reserve will be the the main one that serves all the trades, though we plan to partner with big token holders and other market makers to introduce their reserve in KyberNetwork. The tokens that we support will be the popular tokens that have high demand and high trading volumes in the market.

We will also partner with wallet providers like MyEtherWallet, Status, Jaxx and others to implement the core features of KyberNetwork. Since most users stay with their favourite wallet, bringing our features to the wallets is the best way to increase the adoption of KyberNetwork.

5.3. Phase 2: Supporting arbitrary pairs of tokens

Est. delivery: Q2 2018

This phase can be easily achieved following the smooth implementation of phase 1. By then, we expect to have more reserves (i.e. market makers) to join KyberNetwork. The number of supporting tokens will increase as we can get more reserves in our platform.

KyberNetwork will also work with other strategic partners to build APIs to allow users in their platforms to efficiently withdraw tokens/ shared fees in prefered tokens. For example, many platforms, projects are employing the fees sharing model in which token holders share all the platform fees (which may be spread in many tokens) collected from platform users. Token holders in these platforms may get their shared fees in, for example, ETH seamlessly via KyberNetwork if these platforms use our related APIs.

5.4. Phase 3: Trading advanced financial instruments

Est. delivery: Q4 2018

Once our development and operations stabilizes, we will deploy phase 3 of KyberNetwork, in which we support trading advanced financial instruments as discussed in Section 4.

We plan to work with decentralized hedge fund platforms (e.g. provided by Melonport) that allow people to invest in trustless hedge fund and get the profit share from efficient fund managements. Our team needs to discuss, exchange and build APIs between the related platforms to enable us to do what we aim to do in a secure way. Similarly, collaborations with ICOs projects that have vesting schemes for their founders, advisors are also important.

5.5. Phase 4: Support cross-chain trades

Est. delivery: End 2018/ Early 2019

The deployment in this phase allows users to trade between Ether/ tokens to Bitcoin, ZCash, ETC and so on. There are two ways to enable this goal: using chain relays (e.g. BTCRelay and ZecRelay) or using interchain communication protocols (e.g. Cosmos, Polkadot). We will watch

the development of these protocols and relays closely to decide which solution will be employed in KyberNetwork.

6. Crowdsale and the KyberNetwork Crystal

A fixed number of KyberNetwork Crystal tokens (KNC) will be distributed to the public in exchange for Ether contribution. The details of how many KNC are distributed, and how the sale is conducted will be publicly available in our blog posts and website.

6.1. Use of tokens

KyberNetwork Crystal (KNC) tokens are required for reserves to participate in the network and to reward various parties who will help generate more trading activities in the platform.
KyberNetwork will rely on various partners, including both software and hardware wallets, blockchain explorers, and on-chain smart contracts to direct users to the platform. These partners will be paid in KNC for every trade that they introduce to KyberNetwork.

Before operating, KyberNetwork reserves need to pre-purchase and store KNC tokens. In every trade, a small fraction (exact numbers are TBD) of the trade volume will be paid by the reserve to KyberNetwork platform in KNC. This small fee represents the reserve's payment in return for the right to be able to operate and earn profits from trading activities in KyberNetwork. The collected KNC tokens from the fees, after paying to the supporting partners, will be ***burned***, i.e. taken out of circulation. The burning of tokens could potentially increase the appreciation of the remaining KNC tokens as the total supply in circulation reduces. In order to determine the network fees, the conversion rate between KNC and ETH will be updated frequently to the Kyber contract by KNC operators, based on the trading rates on various exchanges.

As an example, for a trade volume of 10 ETH with a 0.01% fee, a corresponding 0.001 ETH worth of KNC will be paid by the chosen reserve to KyberNetwork as a fee for the use of the reserve dashboard and access to network users. Suppose the rate of KNC at the trading time is 1 KNC for 0.1 ETH, the reserve needs to pay 0.01 KNC to the Kyber platform. The wallet/ website that helped the user initiate the trade will get, supposedly, 5% of the fees, or 0.0005 KNC. The remaining 95% of the fees, or 0.0095 KNC will be burned forever.

This approach would increase the demand of existing KNC tokens as the trading volume happening on KyberNetwork increases. The approach also properly rewards all participants who help grow the ecosystem. KNC token holders can easily track the total supply by reading from the contract, without relying on any off-chain accounting firm.

7. Acknowledgement

We thank our advisors, namely Wong Lee Hong, Vitalik Buterin, Leng Hoe Lon, Prateek Saxena and our friends, namely Tsun Ngai Lee, Stelian Balta, Reto Trinkler for their feedback on the earlier version of this paper.

8. The team

8.1. Core members

1. **Loi Luu**
   Loi Luu is a researcher working on cryptocurrencies, smart contract security and distributed consensus algorithms. His research publications are available online, and he is a regular invited speaker at Bitcoin and Ethereum workshops such as DevCon2, EdCon, Scaling Bitcoin.
   Loi believes in the force of the Ethereum and Blockchain technology. Much of his work revolves around this community. He developed Oyente, the first open-source security analyzer for Ethereum smart contracts. Next, he cofounded SmartPool, another open source project which embraces decentralization of mining pools in existing cryptocurrency. He continues to champion decentralisation and trustless properties of the Blockchain with KyberNetwork, taking inspiration and developing value for the community.

2. **Yaron Velner**
   Yaron Velner is a researcher and a co-founder of the SmartPool project. His research is focused on aspects of game theory incentives in blockchain protocols and formal verification of smart contracts. He holds a Phd in computer science from Tel Aviv University. In his Phd thesis he investigated applications of game theory techniques to formal verification of computer programs and systems.
   Yaron is also an experienced software developer with over 10 years of experience as a senior software engineer and a technical leader at EZchip semi-conductors (recently acquired by Mellanox technologies). At EZchip he was a member in the data structure and algorithm team, which developed novel data structures for IP routing.

3. **Victor Tran**
   Victor Tran is a senior backend engineer and Linux system administrator. He has experience in developing and building infrastructure for multiple social marketing platforms and advertising networks. He is interested in building high performance multi-platform applications.

Victor co-founded and was CTO of several startups in social marketing. He built and maintained platforms which handled millions of monthly active users. Victor is currently the lead engineer in the SmartPool project.

4. **Cuong Nguyen**
   Cuong is a senior web developer with several years building interesting web applications. He recently spends most of his time on experimenting with various blockchain platforms including Bitcoin, Ethereum and IBM's Fabric ledger.

8.2. Advisors

1. **Wong Lee Hong**
   Wong Lee Hong career spans across various industries over 3 decades. He has extensive distribution and business development experience in consumer electronic, multimedia, computer gaming, internet and the banking sectors. The second half of his career was spent developing the Internet Banking capability of a major financial institution, venture capital activities in strategic startups and regulatory management role, dealing with banking regulators in Asia in matters relating to banking technology and operations. At present, he is a Blockchain enthusiast and investor.

2. **Leng Hoe Lon**
   Leng Hoe Lon co-founded Shentilium with National University of Singapore, with the aim of using the latest data-driven technology to drive business decisions and gain competitive edge. He also co-founded TrackRecord Asia, with the vision that anyone can learn to trade in the financial markets profitably within a professional risk management framework. Prior to this, he held various positions in the financial industry including Deutsche Bank (London and Singapore), JPMorgan (Singapore), ABN Amro (Singapore). He was a Managing Director in Goldman Sachs' Asia Macro Trading group in HK and Asian FX trader in London. He was also CEO of Tudor Capital Singapore, a global macro hedge fund.

3. **Prateek Saxena**
   Prateek Saxena is a research professor in computer science at National University of Singapore. He works on blockchains and computer security. His research has influenced the design of browser platforms, web standards and app stores widely used today. He has received several premier awards such as the MIT TR35 Asia.

4. **Vitalik Buterin**
   Vitalik is the Founder and Chief Scientist of Ethereum. He is also both the Founder and a writer for Bitcoin Magazine, a venture that marked the beginning of his career in crypto in 2011. He is interested in creating secure, efficient, and trustworthy systems and advises a number of projects in the crypto space.

5. **Pandia Jiang**
   Pandia is the founder of LinkTime and an organizer of several Ethereum workshops in China and world wide. Pandia is an expert at building and managing community, providing crypto-business advisory in China.