8x Protocol

Decentralised recurring payments on the Ethereum blockchain

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Abstract

The following paper outlines how the 8x protocol facilitates recurring cryptocurrency payments for software-as-a-service business vendors. Currently, there are only solutions to accept one-time cryptocurrency payments for vendors. 8x is designed to tackle this problem through Ethereum's decentralised blockchain ledger, the ER2C0 token standard, use of stable coins (such as MakerDao) and a network of distributed "processors". Subscription plans are registered in a smart contract and customers can subscribe to them directly. In order to execute the transaction, payments are claimable to a network of "processors" who in turn receive a percentage fee of the original subscription payment made between the consumer and vendor. In order for processors to make payment claims, the 8x native token must be staked.

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1 Introduction

Cryptocurrencies were introduced to the world in 2012 when Satoshi Nakamoto published the Bitcoin whitepaper. The key innovation behind it was the solution to the double spend problem through cryptographic proofs. Bitcoin's first application was the ability to make cross-border payments to anyone in the world through a trust-less network of miners. To make a payment, the sender signs the transaction with their private key and broadcast it to the network. This makes the execution of a cryptocurrency payment "push" based - as money is transferred from one party to another without any intermediaries.

In a traditional centralised banking system the consumer thinks they're paying a vendor directly. Instead they're actually authorising the vendor to "pull" from their bank account directly.

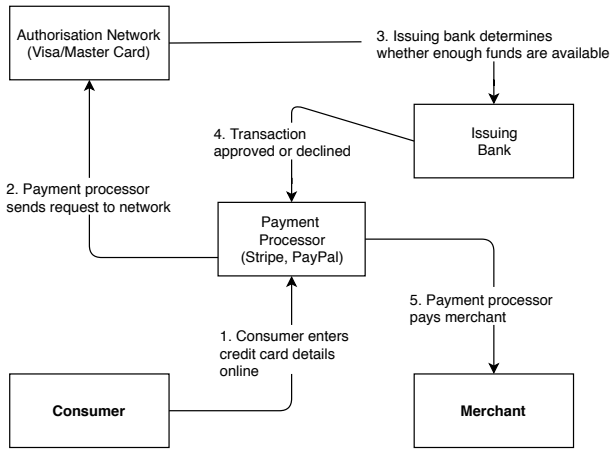

Figure 1: A figure of the existing centralised banking "pull" system. Unless the issuing bank gives approval, the transaction is not made.

While it isn't hard to realise the benefit of eliminating all the intermediary parties, the fundamentals of cryptocurrency "push" based payments make it difficult to pre-authorise transactions for the purposes of recurring payments. To make a pre-authorised recurring "push" payment system a party is required to trigger the transaction in the first place.

Another major problem of using cryptocurrencies for recurring payments is the volatility of the price. For any merchant, whether they prefer to deal in fiat or cryptocurrency, paying in a currency like Ether is not a good medium of transfer due to the speculative nature of the market. Potential solutions to this problem include using 3rd party oracles to fetch the latest exchange rate, although this puts an extremely high level of trust in external parties. It also introduces a potential threat to the correctness and reliability of the system to ensure fair exchange rates are used to facilitate the exchange of goods and services.

Date	**ETH/USD**
First	$
April 2018	396
February 2018	1126
January 2018	747
December 2017	443
November 2017	306
October 2017	301

Table 1: Price of Ether between October 2017 and April 2018

2 Existing Work

In terms of a complete recurring payments solution, Coinbase Commerce supports recurring payments for merchants. Although it comes with three limitations:

1. Requires users to have a valid Coinbase account with cryptocurrency stored on their wallet (for users and vendors).
2. Merchants have to store cryptocurrency in their wallets, thus exposing them to the volatility of cryptocurrencies.
3. Only supports Bitcoin which is typically slow to transfer and comes with transaction fees compared to currencies such as Ether.

An integral part of 8x's protocol is the use of stable coins such as MakerDao. Unlike centralised stable coins such as Tether, MakerDao is fully collateralised (by Ether) and maintains a 1:1 ratio to USD. MakerDao achieves this through collateralised debt positions (CDPs) backed by their Ether. As the price of Ether goes up, CDP holders can borrow more Dai. Should the value of Ether go below a 100% collateralisation ratio to Dai, CDPs are liquidated and Ether is returned back to the owners of the CDP. In the case of a black swan event (flash crash of Ether's price), MakerDao's second token, Maker/MKR, is liquidated on the open market to raise additional capital to maintain the collateral. While Dai has temporarily lost it's peg to USD in the past, the target rate set by MKR holders ensures that the peg is quickly restored.

Part of enabling recurring payments on the blockchain is the repeated execution of a financial transaction between two parties. Recent research into scaling Etheruem has spawned the creation of layer 2 scaling technologies such as state channels. The concept behind state channels is to open a "bar tab" like account on-chain and let both parties transact until they want to close the engagement and settle their account. In the case of any fraudulent transactions, a user can submit cryptographic proofs that the other party cheated or attempted to cheat and get their money back. Although this may sound suitable for recurring payments, it doesn't take into account that monthly subscriptions are a way to reduce the burden of one-time payments for subscribers. Creating state channels that require the total subscription up-front may also not be economically viable for individuals. It would also eventually require a top-up after the up-front payment is made as time goes on.

To enable "pull" based payments, a potential method is creating a pre-paid subscription escrow smart contract where users deposit their money into at the start of each month. Having a single smart contract hold all user funds can lead to the contract being subjected to sophisticated and targeted attack vectors. An example of this is the $30 million DAO hack that happened in 2016, despite having the smart contracts audited. 0x protocol (decentralised exchange) has a unique solution by taking advantage of the ERC20 standard's approve functionality. Once an off-chain order is fulfilled on-chain, the transfer proxy contract is able to take the ERC20 tokens directly from the user thus eliminating the need to store them in a single smart contract. The transfer proxy does not contain any business logic which allows for an upgradable smart contract architecture.

Scheduling tasks on the blockchain is a problem that is still being worked on. However, the closest solution till date is the Ethereum Alarm Clock (EAC) project by Piper Merriam. With EAC, a smart contract can ask the alarm clock service to schedule a transaction at a particular date and provide a reward to the executor of the scheduled transaction. To prevent execution conflict between an increasing number of parties wanting to earn the reward, a claim system is setup. This requires executors to claim the right to execute the payment and then collect the subsequent reward. The earlier the claim is made, the less the total % of the reward is earned. This creates a game where executors are competing against each other - decreasing the likelihood of claim conflicts. Also, to claim a payment, executors need to provide an initial deposit. This is in the case that a payment is not executed by the claimant on time and the executor can be punished by losing their deposit.

3 System Overview

Figure 2 below shows the series of steps taken by vendors, consumers and executors in order to facilitate the 8x protocol for decentralised recurring payments.

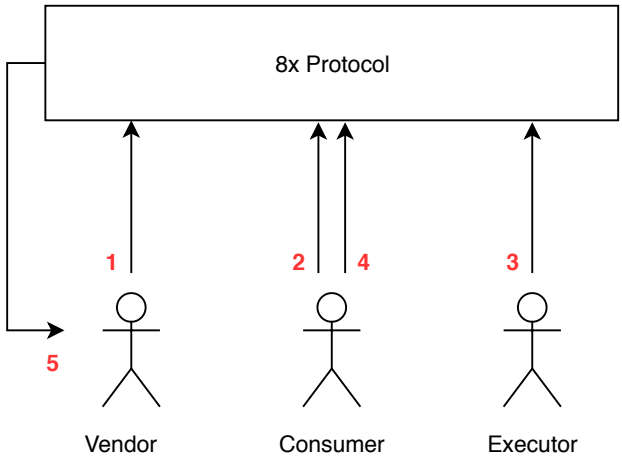

Figure 2: a conceptional diagram of how each party will interact with the 8x protocol

1. Vendor adds subscription plan specifying how much is to be charged and at what interval (in days). Gas is required to execute this transaction, although it only needs to be done once and is marginal to execute.

2. Consumers subscribes to plan created by the vendor. This is assuming they already have DAI on hand. If they don't, Kyber Network can be used to faciliate the immediate exchange of ETH to DAI. This eliminates both parties having to deal with volatility.

3. Executors on the network compete to claim the right to execute the payment on the network. We can almost always guarantee the execution of payments due to the economic incentives that make it very profitable to execute a transaction right before the time it is due.

4. At the time of execution, funds are taken from the consumer. Since user funds aren't stored inside the smart contract itself the attack vector for the smart contract is significantly reduced. If the proxy contract making payments is ever compromised, it can be killed and prevent access to user funds.

5. The 8x protocol then directly transfers the tokens to the vendor. This is advantageous for vendors as they don't have to wait for rolling payments thus improving cash flow.

The following setup tackles all the problems proposed with making recurring payments possible on the blockchain.

4 Smart Contract

4.1 Architecture

The entire protocol is run on the Ethereum blockchain through smart contracts written in Solidity. Standard gas fees applies to interact with the smart contract for vendors, consumers and processors. Apart from the transaction fee made during a subscription payment no additional costs are applied. Considerations have been made to ensure expensive operations such as CALL are minimised where possible.

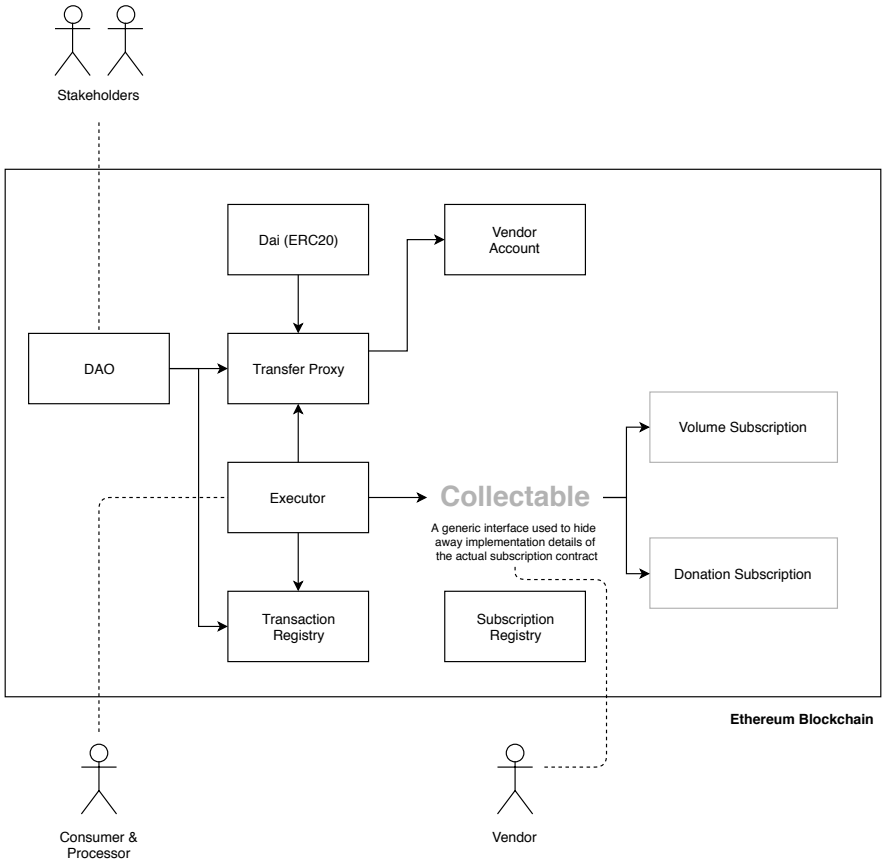

Figure 3: a high level view of how the different smart contracts will interact with each other to create a decentralised payments protocol

4.2 Transfer Proxy

As discussed in the "previous work" section, 0x's model of keeping a transfer proxy is one that has been implemented into this architecture. By having a single component authorised and responsible for taking and making payments we can store the logic for these payments in the executor contract. While the logic for payments should be tied to the information returned from the collectable interface, having a hard coupling could lead to costly immutability down the line. The transfer proxy has an array of authorised addresses which grant access to pull funds from users and pay vendors although this is controlled by a Decentralised Autonomous Organisation (DAO) or multi-signature wallet with a time lock of 2 weeks to propagate changes. The only exception to the time-lock is to kill the contract to revoke access to user funds in the case of an attack By having mutliple authorized addresses, a new executor contract can be deployed and the old one can be deprecated. When the transfer proxy is called, it uses the ERC20 transferFrom() function to send DAI directly from the user's wallet to the merchant.

4.3 Executor

The executor component is where the core logic and functionality of the smart contract lies. Consumers and processors interact with it directly in order to claim and make payments. Since all subscription contracts adhere to the collectable interface, the logic for how much money should be charged and whether the subscription is valid is in the actual subscription contract. The executor simply interacts with the exposed public methods. The only extra power the executor has is to cancel a user's subscription in the case that they don't have enough funds. When a user subscribes to a subscription, the executor calls the transfer proxy to facilitate the transaction and adds the payment to the transaction registry.

4.4 Transaction Registry

As soon as the first successful payment is made by the consumer (usually when they subscribe), the transaction is added to the transaction registry which creates a data object for the next payment. This newly created object is claimable to any processors on the network who in turn will earn a fee. The game theory and mechanics of this are still under work however, the earlier a processor claims a payment the less total % he gets of the total fee of the proposed 1% fee they can claim. The remainder of the fee is used to purchase 8x tokens using Kyber Network and then burned.

4.5 Collectable

Initial plans for the architecture included a separate subscription contract and plan contract for vendors and consumers to interact with. Although this kind of rigidity runs into problems quickly when something like a donation subscription contract needs to be implemented as the user is in full control of how much they want to give. For this reason a more general purpose architecture has been made which facilitates the addition of new subscription contracts as long as they adhere to the interface. Currently the interface methods include:

1. Check whether the subscription is valid
2. Get the subscription owner's balance
3. Return how much the subscriber owes from their subscription
4. Terminate the subscription if they don't have enough funds

If a user doesn't have enough DAI to pay for their subscriptions, an email will be sent to them to remind them to top up. These email details and reminders will most likely be hosted on a centralised server due to the unwanted nature of publicly exposing an email address to public key on the blockchain.

4.6 Subscription Registry

Part of the Cyberphunks movement is to provide power back into the hands of the people instead of large corporations. The subscription registry allows users to view all the services they're currently subscribed to through mappings stored in the contract. This therefore allows them to view currently subscribed services, when the next payment is due and cancel any unwanted subscriptions. Credit card payment subscriptions lead to users being notified of what they're subscribed to once they see payments in their bank statements or are required to find the "Cancel Subscription" button on a vendor's website.

5 Threats to Validity

5.1 Reliance on MakerDao

Throughout this whitepaper, mentions of using MakerDao as a form of protecting vendors and consumers against volatility has been used. This raises the question about whether bounding a protocol to a currency is the right decision. Apart from unknown attack vectors in the MakerDao system, the ability to use other stable coins that may be pegged to other currencies (AUD, INR, NZD etc) could be important in the future. We may also reach a point where Ether itself may not be as volatile as we know it today. It is for this reason that when creating a subscription plan, the ability to specify a ERC20 token address is included. While the functionality will not be exposed to end-users in the first few iterations of the protocol, the option will be there regardless.

6 Summary

1. Use of stable coins such as MakerDao eliminates risk of cryptocurrency volatility when purchasing goods and services.
2. Letting users stay in control of their funds elimitates the risk of high risk attack vectors.
3. Allowing a network of competitive processors to execute payments and earn a percentage of the fee ensures transactions are always executed.
4. Creation of SDKs can allow dApps and regular web apps to accept recurring crypto payments.
5. Single interface for users to manage all their recurring subscriptions.
6. Loosely coupled smart contract architecture allows easy protocol improvement.

7 Acknowledgements

I'd like to thank my family and closest friends for bearing with me as I continue to ramble on about the possibilities of the blockchain. I'd also like to show my appreciation to the attitude of the community in sharing their knowledge openly and freely. Without some of the information available out there, it'd be almost impossible to derive a solution presented to you in this whitepaper.

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