A Borderless Credit Investment Network Creditcoin

Whitepaper

Published March 2022
1st publication - November 2019

Creditcoin

Abstract

Creditcoin is a permissionless blockchain designed to facilitate a borderless credit investment network. At its most basic level, Creditcoin matches and records loan transactions between parties. Credit transaction history is stored objectively, allowing transacting parties to audit risk and screen potential investments.

By bootstrapping transparency into its ecosystem, Creditcoin can help facilitate the trust and market information required for efficient lending markets, freeing DeFi from its over-collateralization requirement, enabling new types of economic relationships, and bridging the gap between cryptocurrencies and the real-world lending economy.

The versatility of the Creditcoin network, its decentralized community involvement, and the engagement of Creditcoin Ecosystem users permits a paradigm shift in the expansion of credit lending markets producing more robust, efficient economies - agnostic of currency platforms.

Decentralized platforms which leverage both lower costs of verification, and reduce the cost of networking, can enable new kinds of decentralized markets designed to empower end-users, rather than platform owners. Helping us build a future of financial inclusion and credit for all.

Table of Contents

Background

Since Satoshi Nakamoto's release of the Bitcoin whitepaper, the usage of blockchain technology and by extension, cryptocurrencies, has rapidly expanded. Distributed ledger technologies including blockchains share several key properties:

- They represent a distributed database with no central point of control (or failure).
- They rely on peer-to-peer communication between nodes to achieve consensus.
- They (generally) afford transparency whilst maintaining pseudonymity.
- They provide transaction immutability/irreversibility.
- They operate via programmed logic.

In conjunction, these properties ensure that blockchain networks are able to record tamper-proof and immutable data in an open and participatory environment. This confers a number of economic advantages.

Firstly, by transparently storing immutable data through decentralization, blockchains allow various parties to agree on the 'true' state of information. This is fundamental to the operation of cryptocurrencies, which allow parties to reliably and independently verify their transactions, without the need for a trusted intermediary to settle and verify that transaction data. In economic terms, blockchains reduce the "costs of verification"[1]. Informational failures or a-symmetries often lead to poor market outcomes – the transparency and certainty of blockchain can help overcome this.

The second economic advantage is a reduction in the "cost of networking"[2]. In today's world, one of the most important currencies we have is our digital data. Yet centralized platforms such as banks, technology giants etc. monopolise this data to extract rents and influence our economic behaviour.

Decentralised platforms can overcome these centralized network effects. By recording data on a transparent and permissionless platform, no single party is afforded informational advantages or monopolistic control over a platform's usage. Instead, end-users can retain sovereignty over their accumulated data records.

Finally, cryptocurrencies have leveraged these two effects to great benefit. Verifying payment is now easy and secure (cost of networking), meanwhile anybody with access to the internet can create a wallet and exchange cryptocurrencies (cost of networking). Combined with the as-of-yet untapped potential of programmable money to enable new kinds of financial instruments, cryptocurrency will inevitably form the backbone of tomorrow's financial system. A system in which people are empowered to be their own bank.

1 Catalini, Christian, and Joshua S. Gans. 2016. *"Some Simple Economics of the Blockchain."* NBER Working Paper No. 22952. Accessed (21/05/2021): http://www.nber.org/papers/w22952.

2 Ibid.

However, cryptocurrency still lacks a developed market for credit-based lending and borrowing. As DeFi's collateralised lending model cannot bridge the gap between crypto and real-world lending, a new type of platform for cryptocurrency credit investments must be established. A platform which leverages the inherent advantages of distributed ledger technologies, openness and trustless verification, to reduce existing information asymmetries and enable a more efficient global credit market.

The developing world represents the ideal grounds for such a network and further blockchain/cryptocurrency adoption. Currently, low trust in authorities, poor market information and underdeveloped financial infrastructures all inhibit economic growth and security.

Creditcoin aims to build a blockchain which helps overcome these barriers, facilitating a borderless, open and efficient market for credit designed to serve the millions of unbanked and underbanked people in the developing world. We believe this is the natural evolution of Nakamoto's original vision for cryptocurrencies - the creation of a sound currency for everyone regardless of borders or nationality.

Credit Markets in Developing Worlds

Globally, over 1.7 billion people still live without access to the formal financial system. These underbanked and unbanked people face systematic challenges when trying to access formal lines of credit. Even though access to credit represents a vital component of economic growth in developing countries, credit markets remain chronically underdeveloped and inefficient. For example, in Nigeria, the private credit to GDP ratio was 11%, compared to 191% in the United States.[3]

Limited access to credit inhibits the growth of developing countries. In Africa, limited access to credit is cited as the single biggest constraint on growth for micro, small and medium enterprises (MSMEs)[4]. And globally, the credit financing shortfall is estimated to be worth $5 trillion, spread across over 130 million different enterprises.[5] Put simply, this is a problem arising due to limited market information, poor infrastructure and restricted networks.

Without access to 'thick' and open financial records, primarily credit history, many lending institutions cannot reliably assess risk or offer loan products. In other words, banks often suffer from adverse selection in less developed financial systems.[6] This exacerbates the usage of informal credit lines where credit information is left unrecorded or siloed. Indeed, the OECD has noted that SMEs lack of "credible financial records'' is their primary obstacle to accessing credit.[7]

This creates a vicious cycle, in which people are forced into informal and expensive channels of lending, which further entrenches their lack of reliable financial history. Beyond this, accessibility to the formal banking system and wider services remains limited due to accessibility limitations such as ID requirements. As a result, millions of people do not accumulate credit history.

In cases where credit history is recorded, this information is accumulated by the lending intermediary, rather than the end-user. By creating siloed information, lending intermediaries are able to exert market power, exploiting information asymmetries to the detriment of the end-user.[8]

A similar problem also exists for local lending intermediaries. Whilst local lending parties

3 World Bank, *"Domestic Credit to private sector (% of GDP)"*, Accessed (02/06/2021): https://data.worldbank.org/indicator/FS.AST.PRVT.GD.ZS?locations=NG-US

4 Babajide Fowowe, *"Access to finance and firm performance: Evidence from African countries"*, Review of Development Finance, Vol. 7 No. 1, 2017, pp.6-17

5 SME Finance Forum, *"MSME Finance Gap"*, Accessed (22/05/2021): https://www.smefinanceforum.org/data-sites/msme-finance-gap

6 Svetlana Andrianova, Badi Baltagi, Panicos Demtriades, & David Fielding, *"Why do African Banks Lend so Little"*, Oxford Bulletin of Economics and Statistics, Vol. 77, No. 3, pp.339-359, 2015

7 OECD, *"New Approaches to SME and Entrepreneurship Financing: Broadening the Range of Instruments"*, 2015

8 OECD, *"Facilitating Access to Finance, Discussion Paper on Credit Information Sharing"*, 2010.

may be able to effectively assess risk and deploy loans, either through local knowledge or data analysis techniques such as machine learning, any records they generate are siloed or untrustworthy. Without the means to reliably audit the lending performance of an intermediary, third-party investors cannot reliably invest lending capital. As a result, institutions, or even individuals, struggle to raise lending capital effectively.

In summary, there is a vicious cycle of poor market information leading to poor market outcomes. The lack of trustworthy and open credit history makes the process of verification (risk assessment) very difficult. Solving these informational asymmetries is crucial if we are to expand the availability of much-needed financing instruments, increase capital-allocation efficiency in developing markets, and drive financial inclusion forwards.

Technical explanation

Creditcoin is an interoperable blockchain-agnostic lending protocol designed to match and record cryptocurrency bullet-loan transactions. At its most basic level, Creditcoin connects investors/lenders and fundraiser/borrowers who register matching loan condition requirements, such as interest rate and maturity dates. Once parties are matched, they are free to view the credit transaction history of any matched parties in order to evaluate any potential investment decisions. Once parties agree to a match, they settle their transactions on a separate blockchain (currently BTC, Ethereum, ERC20 and Gluwacoin are supported) with every stage of the loan process recorded on Creditcoin by mining nodes using a plugin to monitor those separate chains. This creates an immutable record of credit transaction history, including loan conditions and repayment records for each loan and wallet.

Each announcement to the Creditcoin blockchain costs CTC. Currently, Creditcoin supports several functions designed to allow various users to: (1) lend, borrow, and repay cryptocurrency using the Creditcoin Network; (2) have decentralised/uninhibited access to other users for the purposes of lending, borrowing and repayment of cryptocurrencies; (3) interact with the network and communicate with other users for the purposes of lending, borrowing and repayment; (4) trust the transaction history of borrowing, lending and repayment transactions recorded on Creditcoin for purposes of verification; (5) View and possess a decentralized public history of users credit transactions which expands with each transaction; (6) Validate transactions through the mining of blocks, receiving Creditcoin in return; (7) Provide an open lending infrastructure that not only facilitates business activities, but versatility in identification credentialing and credit scoring.

How Creditcoin helps us solve the problem

Reducing the Costs of Verification

Real-world lending necessarily relies on trust. Trust is based on the ability of lenders, or other investing parties, to gather reliable market information from which to assess the risks of a prospective lending investment. The most valuable form of information for assessing risk is attributable credit history. By building a blockchain to record on-chain credit transaction events, Creditcoin offers a way to record immutable, secure and open credit transaction data for purposes of verification and risk assessment.

In its most basic form, credit history is tied to wallet addresses. This means that individuals without access to a bank, or other financial institution, can accumulate credit history as long as they hold a crypto wallet. The only requirement is the use of a Creditcoin compatible chain (currently BTC/ERC20), allowing Creditcoin to serve the

unbanked.

Cryptocurrencies leverage blockchain to create a robust and auditable registry of transactions[9], ensuring that transaction data recorded on Creditcoin is highly reliable. Therefore Creditcoin can effectively be used as a tool for auditing and risk assessment purposes. Lending intermediaries can use the credit history of individual wallets to help assess the risk-profiles of any potential borrowers and make informed lending decisions, thereby reducing adverse selection risks. However, it should be noted that this value can only be fully realised within a decentralised ecosystem once provable identity verification layers are added to the Creditcoin ecosystem. This step is planned for phase 3 discussed in further detail below.

Additionally, by recording loan-cycle transactions on Creditcoin, lending intermediaries can better raise further lending capital. By transparently recording their loan transactions and performance on Creditcoin, fundraisers (lending intermediaries) build credit. Potential investors can reliably audit business performance. By improving market information, counterparty risk and uncertainty is reduced, trust is increased, and a more efficient flow of lending capital into lending intermediaries can be achieved.[10] See phase 2, discussed in further detail below.

By recording transparent credit history data for the purposes of verification, Creditcoin bootstraps transparency into its ecosystem, reducing informational asymmetries between transacting parties. Credit information sharing has been proven to reduce default rates.[11] Therefore, by improving market information Creditcoin decreases the risks of investment for lending and investing parties, and by extension lowers interest rates for credit-worthy end-users.

Whilst not directly related to Creditcoin, programmable money (smart-contracts) will serve to further reduce uncertainty within the wider Creditcoin ecosystem - by creating additional loan conditions and enforcement mechanisms.

Reducing the Costs of Networking

Network effects describe the increasing economic utility a network offers as its user base grows. Facebook is considered a valuable network due to the number of parties it lets you connect with. However, networks on centralized platforms also create market power for the network holders.[12] In the age of digital platforms, the most valuable

9 Fran Casino, Thomas K. Dasaklis, Constantino Patsakis, *"A systematic literature review of blockchain-based applications: Current status, classification and open issues"*, Telematics and Informatics, Vol. 36, pp. 55-81, 2019

10 Maik Dierkes, Carsten Erner, Thomas Langer, Lars Norden, *"Business credit information sharing and default risk of private firms"*, Journal of Banking & Finance, Volume 37, Issue 8, 2013, pp.2867-2878

11 Samuel Fosu, Albert Danso, Henry Agyei-Boapeah, Collins G. Ntim, & Emmanuel Adegbite, *"Credit Information sharing and loan default in developing countries: the moderating effect of baking market concentration and national governance quality"*, Review of Quantitative Finance and Accounting, pp.55-103, 2020

12 Cathy Barrera, *"The Blockchain Effect: Network Effects without Market Power Costs"*, Accessed (24/05/2021): https://medium.com/mit-cryptoeconomics-lab/the-blockchain-effect-86bd01006ec2

asset these networks accrue is data. In such a model, platforms can monopolistically leverage or sell this data for their own advantage, extracting rents and creating market inefficiencies.

The same market dynamics affect the global credit industry. A limited number of parties possess the information required to assess risk - be it a person, business, private broker or any other kind of lending intermediary. The majority of this valuable credit data is siloed and monetized by existing credit platforms, as opposed to the end-user. The problem is one of data-ownership.

By decentralizing data and building a permissionless blockchain, Creditcoin seeks to bypass the network effects built into the closed-shop financial system of credit, giving people the opportunity to control their own accumulated credit history. Any party can record their credit history on Creditcoin for any other party to view, audit, and potentially transact with, creating an open network for credit information sharing. By reducing informational gaps, parties within credit markets face greater competition for capital, increasing overall lending whilst lowering interest rates for both end-users and lending-intermediaries[13].

This open economy model allows any party to use Creditcoin in order to compete for funding, create a business, invest their money, form a lending pool or build an application on top of Creditcoin. All without any form of centralized control.

By decentralizing credit history and opening-up market information to all market participants, the possibilities for competition will increase. Investors can access a new class of investment product. It will also improve the market for borrowers and lending intermediaries, who can draw from a wider pool of competing investors, as all parties compete on a level-playing field with open market information.

Reputational incentives are considered more important for facilitating effective credit markets than legal enforcement contracts[14]. Creditcoin is designed to function as an open reputational ledger. As the network expands, the reputational damage caused by repayment failure will increase. This will create a self-reinforcing network incentive for repayment as the network grows, reducing loan default rates, and facilitating overall lending volume increases[15].

Transparent networks can also have more widely positive macroeconomic effects. Credit information sharing reduces the likelihoods of banking crises, especially in developing

13 Tullio Jappelli, and Marco Pagano, *"Information Sharing, Lending and Defaults: Cross country Evidence"*, Centre for Studies in Economics and Finance, Working Paper No. 22, 1999

14 Ernst Fehr, and Christian Zehnder, *"Reputation and Credit Market Formation: How Relational Incentives and Legal Contract Enforcement Interact"*, IZA Institute of Labour Economics, Discussion Paper No. 4351, 2009

15 Tullio Jappelli, and Marco Pagano, *"Information Sharing, Lending and Defaults: Cross country Evidence"*, Centre for Studies in Economics and Finance, Working Paper No. 22, 1999

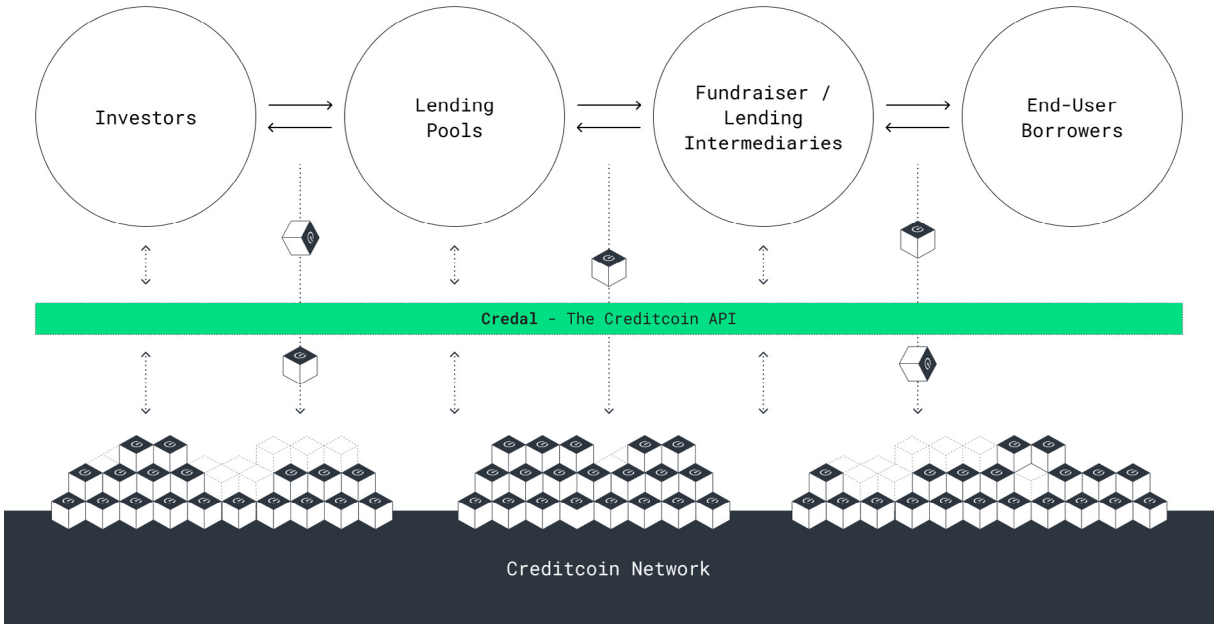
countries, due to its moderating effect on adverse selection and bad/risky loans[16]. A transparent and open standard for international credit history can help build a more stable and secure global financial system.

Open networks are the most valuable networks and first movers often build the biggest networks. The internet was the first open information network, Bitcoin was the first open value network, Ethereum was the first open programmable-value network[17], and Creditcoin is attempting to become the first open credit network.

16 Berrak Büyükkarabacak & Nevan Valev, *"Credit Information sharing and banking crises: An empirical investigation"*, Journal of Macroeconomics, Vol. 34, No. 3, pp.788-800, 2012.

17 Aaron hay, *"Crypto and Network Effects"*, Accessed (25/05/2021): https://medium.com/coinmonks/crypto-and-network-effects-e66e69e754d3

The Creditcoin Network



The Creditcoin Network consists of 1) Investors that fund the loan processes by adding Ask Orders onto the blockchain, and depositing funds when loans are made, 2) Lending Pools that comprise an aggregation of all Ask Orders in addition to Gluwa Capital, 3) Fundraisers or Lenders that add Bid Orders for Loans in to the market, and End-User/ Borrowers that create the demand for funds and therefore make the market. Posting transactions or retrieving transaction data to/from the Creditcoin Blockchain will utilize Credal - the Creditcoin API. These stakeholders can be further explained as follows:

Investors - Investors can be individuals or large lending institutions interested in engaging in the Creditcoin Credit Investment network, facilitating loans for fundraisers and borrowers, essentially floating the market with liquid funds. Generally, these stakeholders are interested in earning fixed interest on pools of liquidity whether that be fiat or crypto. Instead of selling crypto to earn, they can simply loan and earn interest and still maintain their holdings. With Creditcoin, there is also the added benefit of being socially responsible and helping the developing world establish credit markets, histories and bringing consumers out of poverty - while advancing decentralized lending. In the case where an Investor is also an independently funded Fundraiser doing business in their respective location - Credal will allow seamless access to transact on the Creditcoin Blockchain. This will be discussed in the Creditcoin Implementation section to follow.

Lending Pools (or Money Markets) - A Lending Pool is formed through the aggregation of investors' Ask Orders on the Credticoin Network. They also can be created with the

technical assistance of Gluwa Capital which facilitates the onboarding process for the Creditcoin blockchain, in addition to providing wallet, exchange, and investment services through the Gluwa-wrapped stable coin, Gluwacoin. Gluwa Capital is a venture-debt fund that invests in startups aimed at progressing the defi lending landscape. Gluwa Fund LP is the limited partnership that exists between Gluwa Capital (General Partner) and Investors (Limited Partners). If you are a fintech lender/startup seeking funds to lend among your community, Gluwa Capital can help through direct investment or by loan tranches. Not only does this build the network of funds available to fundraisers around the world, but it also provides greater access to capital for borrowers who typically do not have access to traditional lending. Gluwa Capital also utilizes the lending pools created through its Gluwa Invest products - namely the Gluwa Savings Accounts, Bond Accounts and Prize-Linked Savings Accounts.

Fundraisers (or Lending Intermediaries) - Fundraisers generally are lending institutions, on the ground in their respective locations, whose business model is to provide lending services to their community constituents - or the end-user/ borrower. Fundraisers register Bid Orders on the Creditcoin blockchain, thus creating a marketplace for lending and borrowing. A fundraiser can take the form of a small to large lending institution, a microfinance lender, an NGO or government agency interested in improving the lives of the unbanked or underbanked. Additionally, these fundraisers understand that the technology needed to establish a lending network, creating secure loan transactions, and credit histories for its users can be costly, slow to build, and insecure - and therefore see the merits of an immutable decentralized ledger brought to bear by the Creditcoin blockchain. Fundraisers will also be able to take advantage of Credal - the Creditcoin API - allowing them to connect and transact with the Creditcoin Blockchain. This will be discussed in the Creditcoin Implementation section to follow.

Borrowers (End-Users) - With a population of 1.7 billion unbanked or underbanked, the borrower is generally the individual in their respective community who has little to no access to traditional banking or lending institutions, and therefore is captured in a cycle of potential poverty. The empirical merits of microfinance, or micro-loans are well documented in the developing world, and are therefore one of the main tenets of why the Creditcoin Network supplies an efficient means towards increased liquidity and economic prosperity for unbanked individuals. With the advent of DLT and smartphones, never before have global citizens been in a position to regain control of their data, their finances (their ability to quickly and securely transact), and their identity. Decentralized identity will allow consumers to access their immutable credit histories, and, through verifiable credentials provided by lenders and other institutions, be able to permission and grant access to future lenders or other institutions through their sovereign wallet. This will be discussed in more detail in Creditcoin Implementation.

If you are a Fintech Lender Startup, or a lending intermediary looking to secure funding for your borrowers, please visit the Gluwa Capital homepage to inquire about eligibility

for potential investment. The sooner you are on boarded to the Creditcoin blockchain, the sooner you can access the vast ecosystem of of Creditcoin investors, as well as be able to utilize Gluwa wallet functionalities, and Credal - the Creditcoin API, making it easy for you to establish connections to the Creditcoin blockchain, record your transactions, and begin gaining the efficiencies of transacting on a blockchain platform for your users.

Credal - The Creditcoin API

Much like what Infura does for the Ethereum Network, Credal does for the Creditcoin Network. Credal is an API middleware layer that radically simplifies the development of your lending app or platform by connecting to the Creditcoin Blockchain with its white-labeled solution.

If you are a Fintech Lending startup, a defi startup, a small to large lending institution, a microfinance/microloan service provider, an NGO or government entity associated with lending in the developing world, or simply a "builder" - a blockchain developer - who wants to build an dApp that transacts on the Creditcoin blockchain, Credal allows the following:

- Access to a vast pool of loaned crypto or fiat funds - a money market of funds with a variety of term limits and return levels.
- Record on an immutable and secure ledger with provisioned access to loan/ lending/financial transactions.
- Utilize a standardized methodology for credit scoring, or complement your own technology.
- Access to a role-based, analytics dashboards highlighting your investments, your loans, your access to lending offers, deals or pools of funds, and view your success rates or performance.
- Ability to deposit funds or drawdown funds with instantaneous settlement and processing.

Credal allows you to build this flexibility into your business, with all the advantages of DLT that the Creditcoin Network offers.

For investors/lenders who do not require access to funds via Gluwa Capital, and who just want to build and take advantage of the public Creditcoin Blockchain, Credal offers a API call cost model. Please contact support@creditcoin.org for more information.

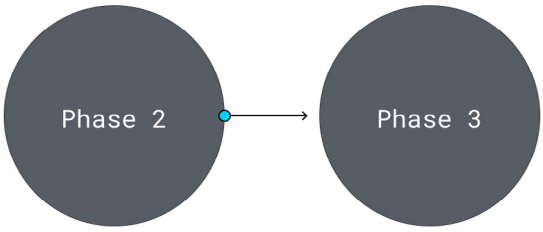
Credal Documentation can be found here.

Creditcoin Implementation

Phase 1	Phase 2	Phase 3
Building the Creditcoin Blockchain protocol (CTC) and the creation of a new credit investment economy.	**Making markets and achieving economies of scale: Onboarding private investors, building Credal - the Creditcoin API, and creating investment products.**	**The equilibrium and efficiencies of decentralizing credit markets: Integrating with other blockchains for identity management, and proliferation of the network.**
• Defining a standardized loan process for recording transactions on a blockchain. • Whitepaper 1.0 is published - Defining tokenomics, and how it will be utilized on the blockchain. • Staging the ICO to launch the CTC token, and launching the CTC mainnet. • ICO funds future milestones for Gluwa and CTC. • Launching CTC on a variety of exchanges	• Building wallet, payment app, Gluwa stablecoin, investment products like bonds and savings accounts with expansion to address multiple currencies. • Expanding public blockchain documentation, as well as stimulating engagement with both the trading and mining community. • Onboarding first lending organizations as well as investors. • Build Credal - an API layer to communicate with the CTC blockchain.	• Expand the presence of Credal among financial institutions to continue to onboard lenders onto CTC blockchain. • Fully integrate most (if not all) fiat and crypto platforms toward seamless transactions. • Build out sovereign identity and verifiable credentials within the Gluwa wallets - to be transferable among lenders in building credit histories. • Build out CTC credit scoring algorithm as a rich data attachment - to compete with traditional credit scoring systems.

Stakeholder Advantages of the Creditcoin Network

With the Creditcoin blockchain and lending network protocols already in place, and with the development of the Gluwa Wallet, the Creditcoin API - Credal, and the presence of the Credticoin (CTC) token live on exchanges worldwide, the following are the advantages for the Creditcoin Network and its users as the network progresses toward Phases 2 and 3.



Investors	
Phase 2	Phase 3
Transparent Investment Transparent and immutable blockchain-native data enables investors to reliably audit and assess the risk of credit investment opportunities. **High rates of return** By removing several layers of intermediation, the Creditcoin ecosystem offers investors a chance to earn higher yields than traditional global debt/bond markets. **Access to new investment opportunities** By leveraging the borderless nature of cryptocurrencies, the Creditcoin ecosystem connects investors to global credit investment opportunities. By enabling new forms of intermediation, novel investment opportunities can be created, including social-impact calibrated loan products. New debt market products with higher yields than global indices, issuance of bonds and clearing and settlement servicing will gain increased efficiencies in cost and speed.	**Opportunities for P2P lending** Through the development of P2P lending platforms based on distributed networks of trust, The Creditcoin ecosystem will be able to bypass further layers of intermediation, enabling direct lending for greater investor returns and lower end-user costs. **Smart Contract lending** Smart contract lending affords investors greater control. For example, a lending pool focused on medical aid may use smart-contracts to create spending restrictions for borrowed funds, limiting loan expenditure to on-chain registered hospitals. This ensures that funds are spent as intended. Similarly repayment mechanisms can be enforced via smart contracts.

Liquidity / Lending Pools	
Phase 2	Phase 3
New sources of capital fundraising By leveraging the borderless nature of cryptocurrencies, lending pools operating on Creditcoin can raise funds from anywhere in the world. **Brokerage fees** Through the process of distributing capital to lending intermediaries, auditing risk, and ensuring legal compliance, lending pools such as Gluwa Capital earn brokerage fees. **Transparent investment portfolio - lowers uncertainty and risk.** By reducing the costs of verification, lending pools can perform cheap and reliable auditing of Fundraiser's lending portfolios. By guaranteeing transparency, Creditcoin reduces the risks of investment. Similarly, potential investors can audit lending pools before investing. **Borderless investment opportunities** By leveraging the borderless nature of cryptocurrencies, lending pools can transparently invest their funds and receive interest payments from anywhere in the world with low fees.	**Access to new financial instruments** Lending pools open the door to various forms of management such as lending funds, socially-responsible investing, tax harvesting, and a variety of derivatives, and securitized instruments like credit default swaps, and fractionalized loan-backed portfolios. The growth of the Crypto Lending industry will necesitate these movements into such asset classes and instruments. **Securitization of Lending Pools** As funds become agnostic to which chains and currencies are transacted seamlessly in trading, portfolios could be built and securitized at various risk levels and sold across trading platforms facilitating not only a shift in bond markets, but a dynamic facet of the asset class. We believe that the Defi Lending industry traverses a variety of markets, instruments and asset classes, and how they utilize economic theory, fundamentals of finance, and predictive behavior (behavioural economics), and has the potential to effect revolutionary social and economic change for those underserved global markets and lifting millions out of poverty.

Fundraisers / Lending Intermediaries	
Phase 2	Phase 3
Better fundraising opportunities - derived from transparent investment portfolios. Increased business cycle performance transparency reduces investment uncertainty, thereby attracting more and cheaper capital. Borderless nature of crypto allows fundraisers to attract capital from anywhere in the world with low transaction fees. **Process cost-reduction** By matching and recording loan transactions on the blockchain, Creditcoin automates the record-keeping process, reducing cost pressures on the value chain. **Real time payment servicing information** At the loan level, lenders will see underlying loan performance in real time - thus increasing transparency and efficiency of loan payments - and to purvey that information to qualified investors.	**Credit-scoring information** Once widely adopted, the credit scores of end-users can be assessed via their credit history on Creditcoin, reducing loan risks. **New opportunities for competition.** Siloed data practices give industry incumbents market power through informational advantages. By improving transparency and therefore market information, the Creditcoin ecosystem should enable a more efficient credit marketplace. **Enables new types of intermediaries** The Creditcoin ecosystem would enable new forms of intermediation. Examples are as follows: • Directly invest funds into a credit union in Africa. The Credit union then deploys those funds to various individuals who act as lenders within local communities. • Non-governmental organisations set up a development programme based around low-interest loans. 'Investors' can provide liquidity to this development programme and transparently track the usage of funds.

End-Users	
Phase 2	Phase 3
Efficient means of transacting with a mobile wallet Consumers have an ability via mobile to connect to funding and commit instantaneous transactions with their personal digital wallet - removing the need for access to accounts behind traditional banking walls. **Cheaper access to capital** Economies of scale within the Creditcoin ecosystem allow greater access to capital without exorbitant fees built into traditional lending. Mass scale also creates a greater level of choice in how borrowers select lenders.	**Build immutable Credit history on a decentralized ledger** Consumers will now have a new credit history recorded for all time using DLT - safe and securely stored away from the large institutional credit scoring mechanisms that currently exist behind proprietary walls. This history will be owned by consumers, but with permissioned viewing privileges given to prospective lending institutions. Lending institutions may have their own scoring mechanism, but Creditcoin will devise their own standard on the network. **Self-sovereign Identity** Through the use of DIDs, decentralized identity will now provide sovereign identity to consumers - thus giving end-user consumers the ultimate privilege and ownership of their data, their finances and their identity - stored and secured on chain and in their personal sovereign wallet. Credit scores and histories will now be permissioned and trustless. Lending institutions will now issue verifiable credentials to end-users for stages (and completion) of the loan process

The Future of Defi Credit Lending and Creditcoin

Total Addressable Market

- With 1.7 billion unbanked (some sources say it is as high as 2 billion), Creditcoin hopes to allay the cycle of poverty exhibited by developing country populations cut off from traditional banking infrastructure.
- There are 1033 large scale Micro-Finance Institutions (MFIs) globally that offered their services to 116.6 million borrowers in 2015. These financial service providers (FSP) have a gross loan portfolio of US$92.4 billion and US$58.9 billion of deposits[18].
- In 2018, 139.9 million borrowers benefited from the services of MFIs, compared to just 98 million in 2009. Of these 139.9 million borrowers, 80% are women and 65% are rural borrowers, proportions that have remained stable over the past ten years, despite the increase in the number of borrowers. With an estimated credit portfolio of $124.1 billion, MFIs recorded another year of growth in 2018 (+8.5% compared to 2017)[19].
- Microfinancing is only available to 20% of the 3 billion global population classified as "poor" while the global market for Microfinance is projected to reach US$313.7 billion by 2025[20].
- Globally, the notional value of bonds outstanding totalled $106 trillion at the end of 2019, with a range of $17 trillion–$21 trillion in annual issuance over the preceding decade[21].

What makes our vision unique to DeFi

Unlike most DeFi protocols which rely on over-collateralized lending, Creditcoin recognizes that this form of lending is unviable for most real-world applications, where most businesses and people are already capital-constrained. For DeFi to scale, a different kind of platform must be established.

Smart-contract based over-collateralized lending is enabled by the following factors.

- Collateralised lending and forced liquidation removes counterparty risk for lenders.
- DeFi lending protocols do not interface with the off-chain world, but rather rely exclusively on verifying on-chain information. Therefore they do not encounter the 'last-mile' problem. Whilst blockchain offers immutable and costless on-chain

18 MIX, *"2015 Global Outreach & Financial Performance Benchmark Report"*, Accessed (04/06/2021):https://www.themix.org/publications/2015-global-outreach-and-financial-performance-benchmark-report

19 Convergences, *"Global Microfinance figures: What are the trends?"* , Accessed (04/06/2021): https://www.convergences.org/en/119115/

20 Reportlinker, *"Global Microfinance Industry"*, 2021, Accessed (03/06/2021): https://www.reportlinker.com/p05799111/?utm_source=GNW

21 SIFMA, *"2020 Capital Markets Fact Book"*, 2020, Accessed (24/06/2021): https://www.sifma.org/wp-content/uploads/2020/09/US-Fact-Book-2020-SIFMA.pdf

verification, how do you interface effectively with the off-chain world to assess risk and enforce loan repayment?[22]

In contrast, real-world lending necessarily relies on trust. Trust which is based on the ability of lenders, or other investing parties, to gather reliable market information from which to gauge risk. The most important form of information is credit scores/history. Credit history on Creditcoin provides a source of credit information which can be reliably used for verification purposes, given that a decentralized blockchain guarantees the immutability and security of on-chain transaction data.

Nevertheless, aggregated on-chain credit information is insufficient for effective assessment of individual borrower risk, especially when relatively fewer transactions exist on the blockchain. Rather, local lending intermediaries are best positioned to assess risk, being able to draw from a wider pool of data than credit history alone. Furthermore, counterparty risk cannot be avoided without collateralization. Whilst transparency can mitigate risk, off-chain mechanisms to enforce or encourage repayment are still necessary until enforceable smart contract models improve.

To this extent, the Creditcoin ecosystem recognizes the need for intermediaries who assess risk and enforce repayment. As such, Gluwa will first be working to integrate its foundational Creditcoin blockchain layer with existing financial institutions and fintech lenders during phase 2. By focusing on existing institutions and adopting an intermediated model which relies on formal B2B contracts, the Creditcoin network can quickly achieve scale and mitigate counterparty risk.

In phase 3 Creditcoin is envisioned to function as a heavily disintermediated credit platform, in which intermediation processes are further decentralized towards a wider pool of ecosystem stakeholders based on open participation. Enforcement in phase 3 is achieved primarily through reputational incentives, the most determinant factor of credit market effectiveness[23]. As the network grows, the reputational incentives for repayment will increase, enabling the network to scale effectively.

Thus, Creditcoin can bridge the gap between crypto-lending and the real-world economy in a way which current DeFi protocols are inherently unsuited towards.

22 Catherine Tucker, Christian Catalini, *"What Blockchain Can't Do"*, Harvard Business Review, 2018, Accessed (28/05/2021): https://hbsp.harvard.edu/tu/4167ec3d

23 Ernst Fehr, and Christian Zehnder, *"Reputation and Credit Market Formation: How Relational Incentives and Legal Contract Enforcement Interact"*, IZA Institute of Labour Economics, Discussion Paper No. 4351, 2009

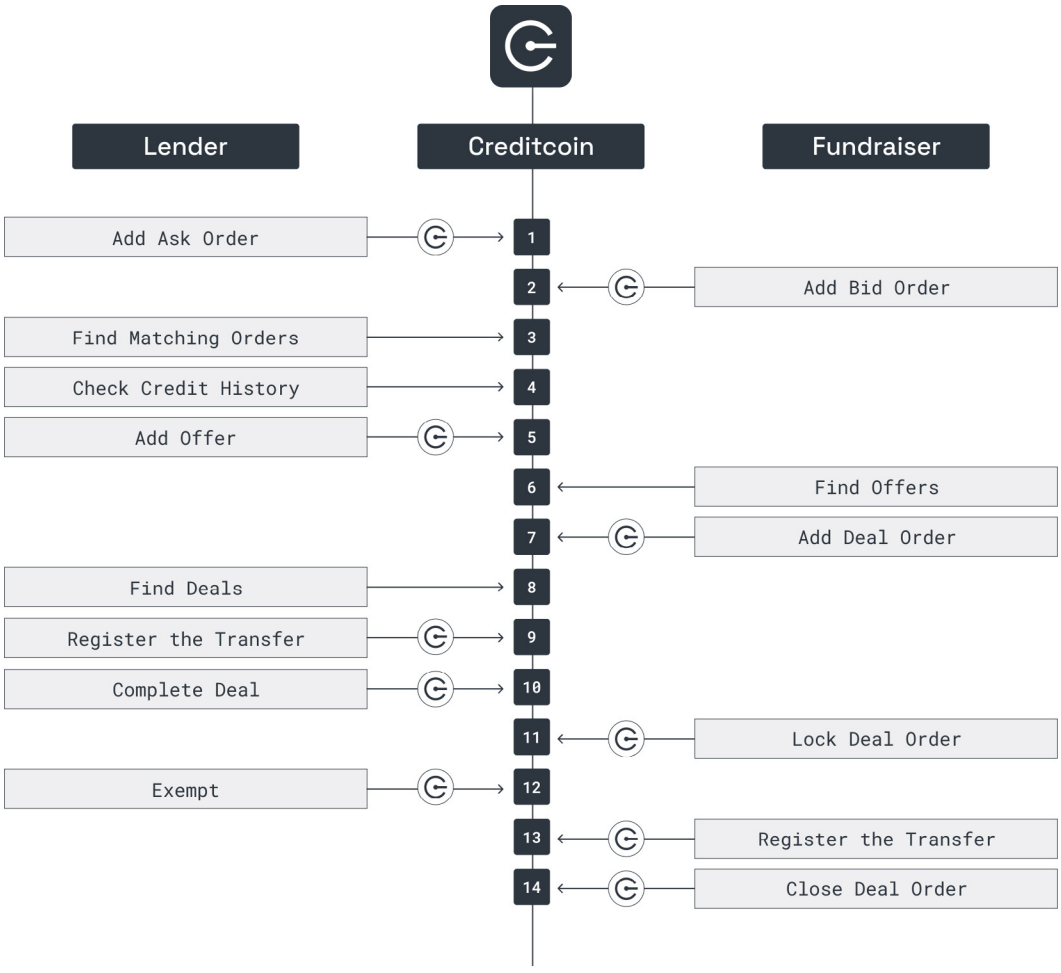
User Flow

Purpose

This section covers a step-by-step guide on how a Creditcoin user will use the blockchain through a loan-cycle. From the perspective of an investor, how to create a loan offer, find a fundraiser for the offer, learn the fundraiser's credit history, and make an investment. For a fundraiser, how to search for a loan offer, request for the loan and make a repayment. The following outline portrays an abridged version of the User Flow. (A more complete description of the User Flow is in the Appendix.)

When do you pay Creditcoin?

Creating a transaction on a blockchain is essentially making an announcement. Creditcoin is a proprietary, utility token that provisions the recording of transactions on the Creditcoin Network. Creditcoin is not required to read transactions, but to write new information on the network, the network charges Creditcoin to have transactions recorded on a new block on the blockchain. Depending on your behavior, each loan cycle will cost from 0.07 to 0.1 CTC to get completed. While Bitcoin has only a send transaction, the Creditcoin network supports a transaction type for each step of a loan cycle. Investors and fundraisers pay Creditcoin to the Creditcoin network to process each stage of their loan. It should be noted that depending on the complexity of the transaction, the average transaction cost of 0.01 CTC can vary.



Fundraiser's Flow

On the Creditcoin network, a fundraiser is an account that borrows funds from another account.

I. **Find a Loan Offer**
A Fundraiser will start a loan-cycle by creating a bid order describing the loan conditions of their choice. The bid order is announced to the Creditcoin network and attracts potential investors.

1. Create a Bid Order
2. Find Investment Offers
3. Create a Deal

II. **Make a Repayment**
A fundraiser can repay the full amount to finish the loan-cycle without the involvement of the investor.

1. Lock a Deal
2. Transfer the Repayment to the Investor

III. **Make a Repayment with an Exemption**
Optionally, a fundraiser may negotiate with the investor for an exemption.

1. Negotiate an Exemption
2. Send a Partial Repayment

Investor/Lender's Flow

On the Creditcoin network, an investor is an account that lends funds to another account.

I. **Find an Investment Opportunity**
An investor will start a loan-cycle by creating an ask order describing a loan offer. The ask order is announced to the Creditcoin network and attracts potential investment deals.

1. Create a Ask Order
2. Find Matching Bid Orders
3. Review a Fundraiser's Credit History
4. Create Investment Offers

II. Make an Investment

If an investor likes a deal, he can accept it by registering the investment transaction on the Creditcoin network.

1. Transfer the Investment to the Fundraiser
2. Complete the Deal

III. Collect a Repayment

A fundraiser can repay the full amount to finish the loan-cycle without the involvement of the investor. However, an investor may choose to exempt a partial amount of the repayment.

1. Negotiate for an Exemption
2. Accept a Partial Repayment

IV. Transfer a Bond

An investor may choose to transfer the ownership of a loan, bond, to another account. We call the new account a “collector.” Once a bond is transferred to a collector, the repayment of the loan will be sent to the collector. This allows investors to liquidate their bonds before the maturity of their loans.

1. Searching for a Collector
2. Searching for a Repayment Order
3. Accepting a Repayment Order

Collector’s Flow

On the Creditcoin network, a collector is an account that receives the ownership of a loan from another account.

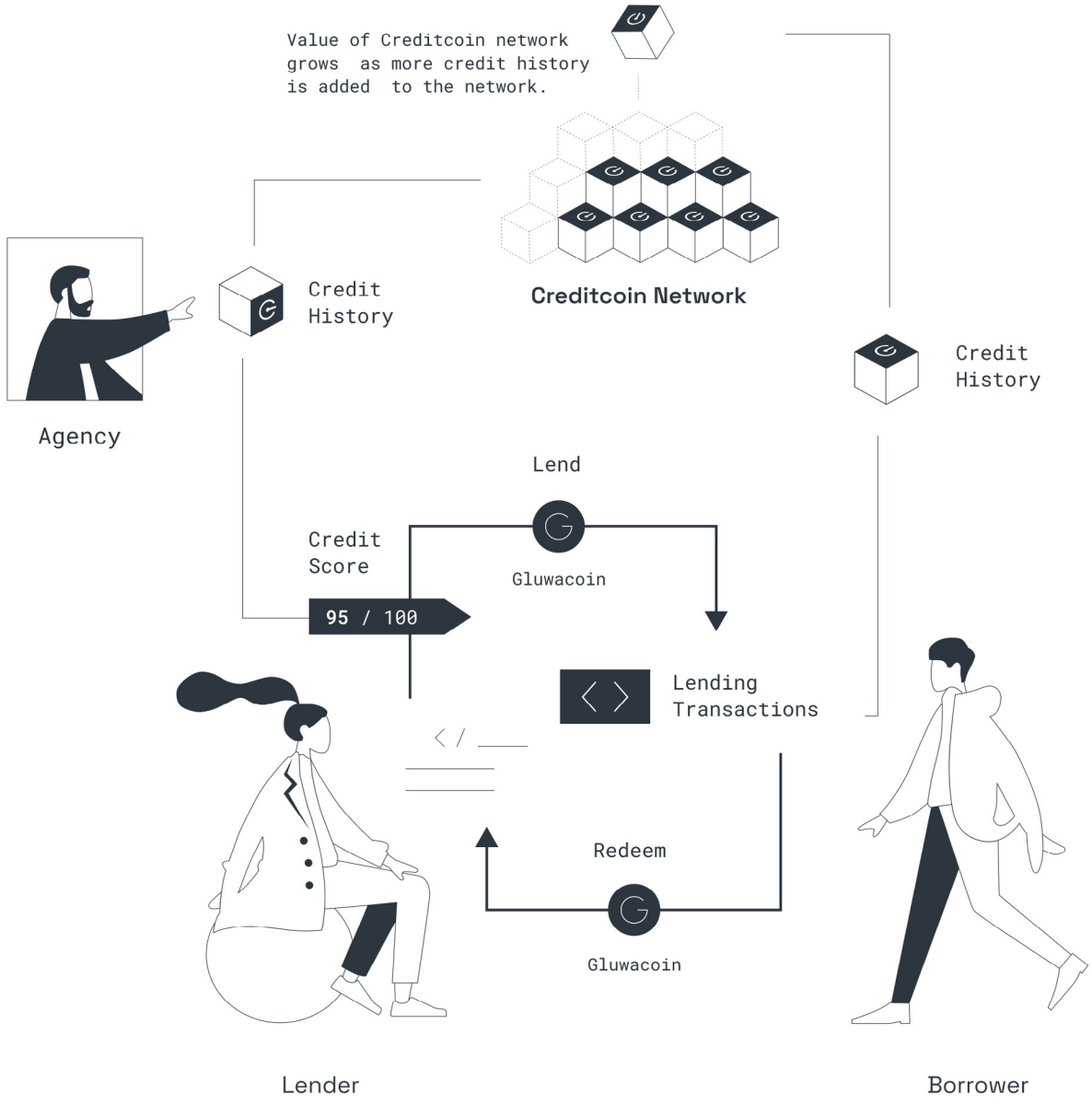
I. Purchase a Bond

A collector can buy a bond from the investor to transfer the ownership of a loan, bond, to his account. Once a bond is transferred to a collector, the repayment of the loan will be sent to the collector. This allows collectors to acquire bonds closer to maturity.

1. Searching for a Bond
2. Create a Repayment Order
3. Searching for an Accepted Repayment Order
4. Close a Repayment Order

The Total Creditcoin token supply will be 2 billion tokens. The token sale is capped at 200 million tokens (10% of total supply).

As stated in the user flow, Creditcoin is a proprietary utility token that fuses together a decentralized credit investment economy. It facilitates transactions between lenders and borrowers, and provides for the recording of transactions onto the Creditcoin blockchain, thus creating an immutable record of credit histories for borrowers. As the ecosystem/network grows, lenders will have an increasing array of borrowers with scored credit histories to choose from, and vice versa.



For lenders, the purchase of creditcoin gives them access to the network, and therefore allows them to add lending Ask orders into the market with the ability to close loan deals with prospecting borrowers.

CTC vs G-CRE

The Creditcoin ecosystem involves two distinct tokens which represent the same underlying asset. CTC is the Creditcoin mainnet token used for transaction fees and mining rewards (based on hyperledger sawtooth). G-CRE is the vesting and trading token (based on ERC-20). G-CRE can be exchanged into CTC using a one-way hook.

CTC

- **Creditcoin Mainnet Token**: CTC is the token used on the Creditcoin Mainnet. It is exclusive to Creditcoin's Hyperledger Sawtooth blockchain network.
- **Creditcoin Network Usage Fee**: CTC is used as a transaction fee to add transactions to the blockchain. CTC transaction fees are returned to the user after one year (detailed explanation below).
- **Mining Reward**: Miner's who run Creditcoin nodes receive CTC rewards in return.

G-CRE

- **Ethereum ERC20 Token**: G-CRE is based on the ERC20 Ethereum network standard. It is not directly usable on the Creditcoin mainnet.
- **One-way CTC swap**: G-CRE can be exchanged/redeemed/swapped for CTC at any time using a one-way hook. Note that CTC cannot currently be swapped for G-CRE.
- **Trading/Vesting token**: G-CRE can currently be traded on exchanges. G-CRE is the vesting token used by the Creditcoin foundation.

Creditcoin's Unique Token Model

Highly variable transaction fees and token-price volatility create significant price uncertainties for parties wanting to transact on current blockchain networks such as Ethereum. Even parties who choose to stockpile a utility token at price X might not be able to effectively offset the costs of higher transaction fees at point Y.

Instead, Creditcoin implements the following token usage process:
Each announcement to the Creditcoin network has Creditcoin as a transaction fee. Fees are locked on the network for roughly a year and then get returned to the user.

Instead of CTC being a single-use utility token like most utility coins, any CTC purchased represents buying a permanent right to use the network. This was introduced as a means to reduce price volatility, and therefore uncertainty, for parties seeking to transact on Creditcoin.

Note however that this implementation is subject to change. In the long-term future, as the mining rewards decrease over time, the introduction of more traditional transaction

fees may be necessary as an incentive for node operators.

Limitations

Creditcoin's token model does not wholly mitigate utility token price uncertainty. Parties may always need to adjust their token usage, exposing them to long-term price volatility when selling their tokens. This would be especially problematic for short-term users, who are forced to factor in the higher costs associated with permanent network rights, and thus face higher price uncertainty for short-term purchasing decisions.

For example, a credit union is experiencing a sudden surge in demand exceeding its CTC transaction capacity. However, the firm has limited capital to spend on more CTC. The firm is unsure of whether this spike in demand is part of a long-term trend or just short-term. The firm may be reluctant to spend its limited capital on a token whose price factors in several years of usage, and whose value could drop in the year before they can re-sell it. In other words, there is a short-term flexibility problem.

Solution

If such a model proves advantageous, there are preliminary plans to introduce a secondary market for CTC staking. With such a system, owners of CTC can lend their CTC transaction capacity to other users for a fee. This solves the above problems, but also allows CTC holders to earn interest on their fixed CTC capital.

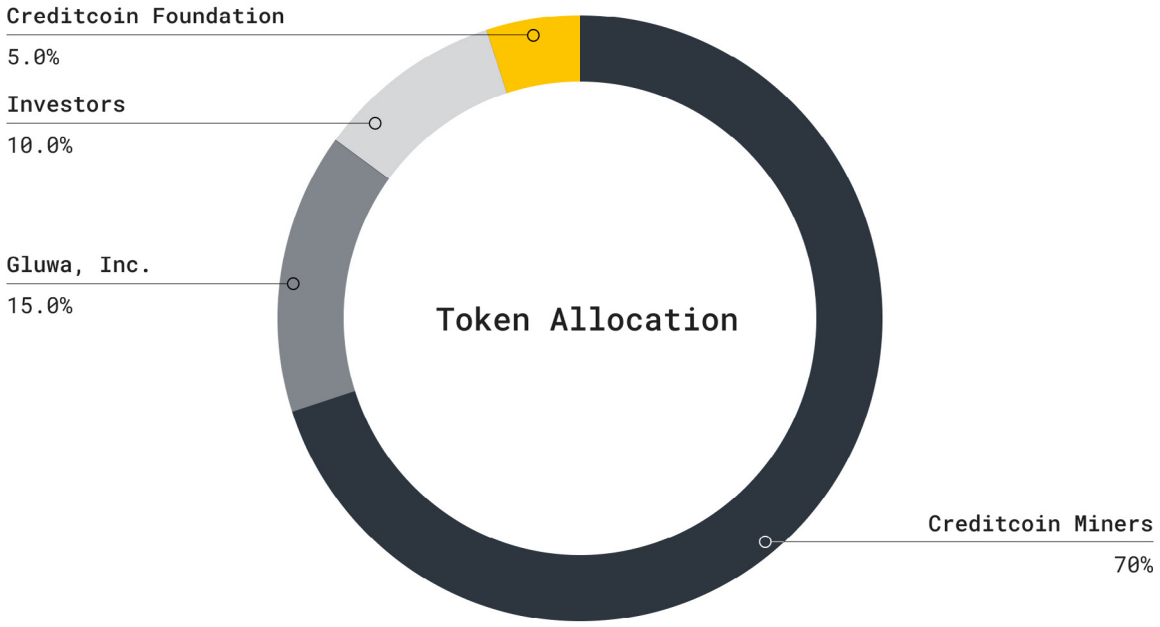
When parties 'rent' CTC, they use it as a normal utility token in which price is determined by short-term supply and demand. Equally, parties can make long-term transaction capacity decisions to purchase CTC based on current market prices, operating with the certainty they need.

Creditcoin Distribution

With any economies of scale, as more Creditcoin is released, distributed and circulates into the economy, the Creditcoin lending ecosystem will continue to maximize its utility as discussed in this whitepaper. Once a Creditcoin is distributed to any user, the user has complete control over its Creditcoin, and therefore gains access and usage of the Creditcoin network, exclusive of Gluwa or any other central organization or entity.

Token Allocation

Creditcoin tokens are distributed to the four major participant groups of the Creditcoin Network:



1. 70% to Creditcoin miners (as mining block rewards) – For provision of investment funds, maintaining the blockchain, and running contracts.
2. 15% to Gluwa, Inc. (Genesis allocation; 6-year linear vesting) – For R&D, deployment, business development, marketing, distribution, and administration costs.
3. 10% to Investors (Genesis allocation; 6-month to 3-year linear vesting) – For funding network development, business development, partnerships, and support. Any unsold tokens were remitted to the Creditcoin Foundation with a vesting period of 6 years.
4. 5% to the Creditcoin Foundation (Genesis allocation; 6-year linear vesting) – For long-term network governance, partner support, academic grants, public works, and community building.

Vesting and Discount Schedules

Each group has a different vesting schedule:

- Investors: 6 months minimum
- Gluwa, Inc: 6 years, linear vesting
- Creditcoin Foundation: 6 years, linear vesting
- Miners: Release half-life of 6 years

For investors, the following vesting periods and discounts are available:

- 6 month vesting: 0% discount
- 1 year vesting: 7.5% discount
- 2 year vesting: 15% discount
- 3 year vesting: 20% discount

The Creditcoin Token Sale

Fundraising

Gluwa, Inc. requires significant funding to develop, launch, and grow the Creditcoin Network. This includes all software development, including mining software, client software, user interfaces and apps, network infrastructure and monitoring tools, software that third-party wallets and exchanges need to support Creditcoin, integrations with other investment software, tooling for web applications and dapps to use Creditcoin, etc. We must deploy the network, facilitate its large-scale growth, market to and bring onboard miners and clients, bring key partners into the ecosystem, and various administrative tasks.

Offering of the Creditcoin SAFT
To raise the necessary funds, Gluwa, Inc. is conducting an offering of SAFTs. This offering is happening in one part:

(1) A private sale for Gluwa, Inc. and Creditcoin community

Token Sale

The essence of the token sale is to bring together a large, diverse group of investors from around the world consisting of those who share the vision of building the most powerful cloud credit network. This includes strategic investors who can add value, and work for, the Creditcoin Network. Ideally, reaching as broad of an investor base as possible; we want people and organizations from countries across the globe, working in many different industries. If our investors represent many different groups, we feel Creditcoin can quickly come to serve those users and spread across these networks. We want investors who will share their skills, their knowledge, and their networks to achieve success. For those inclined, we have structured the token sale with discounts to reward those groups of investors that can help us build the network through a variety of vesting periods. (As with any risky investment, Gluwa, Inc. and Creditcoin cannot make guarantees or predictions of value.) We are, therefore, legally restricted to involve only accredited investors (global investors accredited to US standards or similar—see the legal section).

Caps

A soft cap is the amount received at which your crowd sale will be considered a success. It is the minimum amount required by your project. A hard cap is defined as the maximum amount a crowd sale will receive. This offering has a soft cap of USD 10 million and a hard cap of USD 30 million.

Token Sale Details

- Instrument: Creditcoin SAFT
- Increasing Price:
    1. As investments are made, the price increases based on the Price Function
- Sale Price Function:
    1. Pre-sale price = min(X, Y) where:
        - X = max($0.85, amountRaised/ $4MM) USD / CTC
        - Y = max($1, amountRaised/ $40MM USD) USD / CTC
            - amountRaised is the actual USD dollar amount that is collected
        - The ETH to USD exchange rate at the time of each individual sale should be used.
- Sales Cap: 200 million Creditcoin (unknown how much this is equivalent to in US dollars, as discounts affect the totals) Soft cap USD 10 million. Hard cap USD 30 million.
- Sales Timeline: Private sale starts on September 1st, 2017.

Token Sale Results

Token Sale Began: Thu, Feb 15th, 2018
Token Sale Ended: Sun, Apr 15th, 2018

All 200 million tokens were purchased and introduced into the market.

Mining and Mining Pools

If you would like to connect to the Creditcoin blockchain, run your own Server and Client to mine Creditcoin, documentation attributed to Miners and setting up a node can be found in our Creditcoin Miner's Manual, and contains a brief description with FAQ.

As of the publication of this paper, a Creditcoin Mining Pool is still in the planning phase toward its creation and implementation. The prospect of a Mining Pool allows groups of miners to combine computational resources, strengthening their probability in finding a block, and ultimately sharing in the rewards for participants in the pool. Please check back at Creditcoin.org for further updates, feature releases, and news.

Governance

The Creditcoin Foundation was founded to support the Creditcoin ecosystem and related technologies. Tae Oh is the current director of the Creditcoin Foundation. The foundation will pursue a non-profit organizational model.

The foundation does not control Creditcoin, nor is it the only organization that can engage in critical development of Creditcoin-related technologies. The Creditcoin Foundation is the first of an open ecosystem of organizations, individuals, and companies that support Creditcoin's evolution and development.

The foundation's mission is to do what is best for Creditcoin's long-term success. Our role is to allocate resources to critical projects, to be a valued voice within the Creditcoin ecosystem, and to advocate for Creditcoin to the outside world. The Creditcoin foundation will fund and support projects which improve the Creditcoin ecosystem, such as bug bounty programs or community projects.

Gluwa, Inc. is the technology provider of Creditcoin. The company maintains the Creditcoin blockchain, the Creditcoin token and other Creditcoin properties (The Creditcoin homepage, Creditcoin Explorer, Documentation and all social channels). The company is not the only organization that can contribute to the development of Creditcoin-related technologies.

Any updates or software upgrades made to the Creditcoin blockchain are currently managed by developers within Gluwa, Inc. Creditcoin is a public blockchain, and is built on top of the Hyperledger Sawtooth Project. The Creditcoin blockchain employs a Proof-of-Work consensus algorithm. If the need arises, the Creditcoin Foundation is not opposed to pursuing alternative consensus mechanisms given their future advantages or efficiencies, although it has no current plans to do so. A more detailed look at its software architecture is appended below in the Appendix.

All decisions pertaining to the Creditcoin blockchain, token and properties are currently made by members of the Creditcoin Foundation and its partners. The Creditcoin Foundation complies with all legal and regulatory requirements stipulated by the countries where it operates. As the number of stakeholders within the network expands, The Creditcoin Foundation intends to modify this governance structure in order to integrate a wider range of stakeholders into the decision-making process.

The foundation actively encourages community engagement through its various channels (Github repositories, public Discord, Forums etc.) to promote upcoming enhancements, projects, and/or further outreach toward the common good of the Creditcoin ecosystem. Any questions or inquiries regarding Creditcoin or Creditcoin Foundation can be directed to: support@creditcoin.org.

Regulatory, Compliance, and Legal Considerations

(Note: This section has not been updated since its original publication in November 2019, and was originally written with respect to the Creditcoin Token Sale)

Currently, digital tokens are being closely and regularly scrutinized by various regulatory bodies around the world, including but not limited to the SEC, European Securities and Markets Authority, and each individual state in the United States. Law regarding ICO's is an evolving area of law, and there is no clear guidance from regulatory agencies, courts, and laws regarding legally-compliant practices for ICO's. As a result, the future evolution of the law and potential consequences are too speculative for the Gluwa to reasonably foresee and act upon. However, Gluwa has taken good-faith measures to account for the evolving law and rules on ICO's and in an effort to comply with such law, but there is still substantial risk surrounding legal compliance for any ICO in light of the little legal guidance. There is a substantial risk that in numerous jurisdictions, including the United States, Creditcoin may be deemed to be a security, meaning such a token must be registered or comply with an applicable exemption from registration. For example, applicable securities laws may limit the ability to hold more than certain amounts of Creditcoin; restrict the ability to transfer Creditcoin; require disclosure or other conditions on you in connection with any sale of Creditcoin; and may restrict the businesses that facilitate exchanges or effect transfers of your Creditcoin. Every user, purchaser, and holder of a Creditcoin is required to make diligent inquiry to determine if the acquisition, possession and transfer of Creditcoin is legal in its jurisdiction and to comply with all applicable laws and any of Gluwa's terms and conditions. Creditcoins and the Creditcoin network may be eliminated by future regulation or legal actions. In response to such action, Gluwa may take actions that adversely impact you and the Creditcoins you hold, including: (a) ceasing operations or restricting access in certain jurisdictions, (b) voiding, refunding or not processing token purchases, or (c) ceasing operations entirely.

Each token holder is: (a) if in the United States, or a U.S. Person (as defined in Regulation S under U.S. Securities Act of 1933 (the "Securities Act")), an accredited investor (as defined in Regulation D under the Securities Act) or (b) if outside of the United States, a non-U.S. Person who is not purchasing for the account or benefit of a U.S. Person (as defined under Regulation S under the Securities Act). Each token holder of Creditcoin is sophisticated in terms of investment, business, and/or blockchain technology, or be able to fend for themselves or have access to the information that can allow such purchasers to fend for themselves with regard to the subject matter of Creditcoin.

Team

Creditcoin was founded jointly by two companies, Gluwa and Aella. Gluwa is the technology provider of Creditcoin and Aella is the initial distributor.

Gluwa

Gluwa is a global team distributed across the US, Canada, South Korea and several other countries. Our team of industry experts have years of experience working in industries including Blockchain Technology, Cryptocurrency Trading, Financial Services, Computer Science, High Traffic Systems, and Clinical Psychology.

Tae Oh
Gluwa
Founder and CEO

Scott Hasbrouck
VP of Engineering

Sung Choi
VP of Investment

Vladimir Kouznetsov
Lead Architect
Blockchain

David Lebee
Lead Architect
Web

Will Ryan
QA Manager

Jon H. Black
Product Manager
Creditcoin

Brendan O'Toole
Product Manager
Gluwa Invest

Jan Van den Broeck, LLM
Product Manager
Gluwa Wallet & Exchange

Nick Pashenkov
Engineering Manager

Ivan Solta
Technical Lead

Carlos Gutierrez
Technical Lead
Blockchain

Investors, Advisors & Partners

Steve Chen
Investor

- Co-Founder of Youtube
- PayPal Mafia

Young Ki Kim
Investor

- President of Samsung Electronics
- Network Business

Tom James
Investor

- Co-founder of Intec
- Angel investor in Zendesk, One Login, Tessian, and others

Stuart Gardner
Investor

- Active investor with a portfolio of 80 startups across five continents
- Founding team at Comufy

Holger Assenmacher
Advisor

- Professor of Cryptography at UC Berkeley
- Co-Founder at Cryptowerk

Leung Kwok
Advisor

- Ex-Investment Manager at GM
- $3+ Billion invested / $5+ Billion returned

Aella

Aella exists to simplify instant credit & payment solutions for emerging markets by offering; instant loans, bill payments, micro-health insurance, investment and peer-to-peer money transfer services. Our products are built to make an impact at the frontier of financial inclusion across the region.

Akin Jones
Aella
Founder and CEO

Wale Akanbi
Aella
CTO

Investors, Advisors & Partners

Michael Seibel
Investor

- CEO of Y Combinator

Brian Armstrong
Investor

- CEO of Coinbase

Bill Paladino
Investor

- Former Group Head @Naspers

Eric Uhrhane
Investor

- Fillmore Trust / Google

Y Combinator

oyster ventures

VY Capital

ZENO VENTURES

FRIÁLE

Gluwa

Public Exchanges

Creditcoin (CTC) is currently being traded on the following exchanges:

OKEX
https://www.okex.com/markets/prices/creditcoin-ctc

Bittrex Global
https://bittrex.com/Market/Index?MarketName=BTC-CTC

GOPAX
https://www.gopax.co.kr/exchange/ctc-btc

Bithumb
https://www.bithumb.com/trade/order/CTC_KRW

Upbit
https://upbit.com/exchange?code=CRIX.UPBIT.BTC-CTC

MEXC Global
https://www.mexc.com/ko-KR/exchange/CTC_USDT

KUCOIN
https://www.kucoin.com/trade/CTC-BTC?spm=kcWeb.B5markets.tradeList.1

POLONIEX
https://poloniex.com/exchange/USDT_CTC

Gate.io
https://www.gate.io/trade/CTC_USDT

Creditcoin and the Creditcoin Ecosystem

The following properties create, utilize and facilitate the Creditcoin Network and ecosystem.

Credal: The only API for Defi Credit Lending

Credal is Creditcoin's API middleware layer that allows connectivity between

decentralized applications and the Creditcoin blockchain. Whether you'd like to aggregate information from the Creditcoin blockchain, or you'd like your decentralized app to communicate with and post transactions to the network, Credal allows this instantaneous and secure functionality.

The Creditcoin Foundation
For all the latest information on Creditcoin, its associated products and services, community development, blog articles, documentation or links to Gluwa, Inc's product suite, or if you need to contact the Creditcoin Foundation, visit https://creditcoin.org.

Creditcoin Block Explorer - https://explorer.creditcoin.org/
The Creditcoin Block Explorer is a web-based interface communicating with the Creditcoin blockchain via the Credal API to detail the latest statistics on mainnet volume, transaction and block history, providing a rich list and links to the community and documentation.

Gluwa, Inc. - https://gluwa.com/
Gluwa, Inc. is the technology provider for the Creditcoin blockchain and therefore utilizes Gluwa's product suite - namely its wallet, payment app, exchange services and savings and bond accounts. For lenders affiliated with Creditcoin, the option to integrate with and build upon Gluwa's wallet infrastructure is available, and provides the easiest way to get your decentralized payments app set up and streamlining it to your particular needs and customer.

Gluwa Capital - https://www.gluwacapital.com/
Gluwa Capital is a venture debt fund that invests in innovative, venture-backed financial technology companies striving for financial inclusion of the unbanked and underbanked. Gluwa Capital provides debt financing and technology solutions to financial institutions hoping to utilize the Creditcoin blockchain for its secure transactions and immutable history. If you are a fintech lender, a local credit union, a large or small lending institution, Gluwa Capital could help you find financing to help you lend to the masses all on the Creditcoin blockchain.

Social Media:
- Creditcoin on Twitter: Creditcoin (@creditcoin)
- Creditcoin on Reddit: r/Creditcoin
- Creditcoin on YouTube: Creditcoin
- Creditcoin on Facebook: Creditcoin - Home
- Creiditcoin on Discord: https://discord.gg/3XPV7uTqsn
- Creditcoin on Medium: https://medium.com/creditcoin-foundation
- Creditcoin on Telegram: Contact @CreditcoinOfficial
- Creditcoin Blog: https://blog.creditcoin.org/

The following provides a more comprehensive description of the User Flow.

Fundraiser's Flow

On the Creditcoin network, a fundraiser is an account that borrows funds from another account.

I. Find a Loan Offer

A Fundraiser will start a loan-cycle by creating a bid order describing the loan condition he wants. The bid order is announced to the Creditcoin network and attract potential investors.

1. **Create a Bid Order**
   A fundraiser can announce the details of his bid order. It includes amount, interest, and maturity. For example, a fundraiser may offer to borrow 100 Bitcoin for a 10% interest per 30 days. The fundraiser will pay Creditcoin as a transaction fee to the Creditcoin network to create the order. Note that the offer is in Bitcoin, not in Creditcoin. On the Creditcoin network, you are not lending or borrowing in Creditcoin, but a cryptocurrency on another blockchain. Currently, the Creditcoin network supports Bitcoin, Ethereum, and ERC-20 token loans.

2. **Find Investment Offers**
   If an investor likes the fundraiser's bid order, he can create an offer. The offer information includes a set of one add order and a matching bid order. The fundraiser can retrieve a list of offers for free.

3. **Create a Deal**
   If a fundraiser likes an offer he received, he can accept the offer by sending a corresponding deal to the investor. The deal will have the exact loan condition described in the offer. The fundraiser will pay Creditcoin as a transaction fee to the Creditcoin network to send the deal.

II. Make a Repayment

A fundraiser can repay the full amount to finish the loan-cycle without the involvement of the investor.

1. **Lock a Deal**
   Before making a repayment, the fundraiser has to block another account from making any change to the deal. Else, we have a potential concurrency problem. The fundraiser may be closing the deal at the same time as the ownership of the loan is sold to another account. In this case, there may be two transfers

registered against the same deal order. The Creditcoin network prevents the problem by requiring a fundraiser to lock the deal before making a repayment. The fundraiser will pay Creditcoin as a transaction fee to the Creditcoin network to lock the deal.

2. **Transfer the Repayment to the Investor**
   A deal includes where the fundraiser would like to receive the investment. Note that the repayment transfer happens on another blockchain (e.g., Bitcoin or Ethereum). The fundraiser may pay a transaction fee on that blockchain, but not on the Creditcoin network.

III. Make a Repayment with an Exemption

Optionally, a fundraiser may negotiate with the investor for an exemption.

1. **Negotiate for an Exemption**
   In some cases, a fundraiser may not be able to repay the full amount but a part of it. If so, the investor may choose to accept partial repayment since it is better than nothing. The investor and the fundraiser can communicate outside of the Creditcoin network and negotiate for an exemption. Since the negotiation happens outside of the blockchain, it does not cost any Creditcoin.

2. **Send a Partial Repayment**
   Once the investor agrees to exempt some of the loan amount, the fundraiser will have to repay the rest. Just like the investment transaction, the repayment transaction also happens on another blockchain (e.g., Bitcoin or Ethereum). The fundraiser may pay a transaction fee on that blockchain, but not on the Creditcoin network.

   Note that in case of repayment with an exemption, the fundraiser cannot conclude the deal on his own. The investor needs to approve an exemption by registering the partial repayment transaction ID to the Creditcoin network. Learn more about the process in the Investor's Flow.

Investor's Flow

On the Creditcoin network, an investor is an account that lends funds to another account.

I. Find an Investment Opportunity

An investor will start a loan-cycle by creating an ask order describing a loan

offer. The ask order is announced to the Creditcoin network and attract potential investment deals.

1. **Create an Ask Order**
   An investor can announce the details of his ask order. The detail includes amount, interest, and maturity. For example, an investor may offer to lend 100 Bitcoin for a 10% interest per 30 days. The investor will pay Creditcoin as a transaction fee to the Creditcoin network to create the order. Note that the offer is in Bitcoin, not in Creditcoin. On the Creditcoin network, you are not lending or borrowing in Creditcoin, but a cryptocurrency on another blockchain. Currently, the Creditcoin network supports Bitcoin, Ethereum, and ERC-20 token loans.

2. **Find Matching Bid Orders**
   Using the ID string of an ask order, the investor can search for matching bid orders. Fundraisers create bid orders by describing the desired loan conditions. The investor can retrieve a list of matching orders for free.

3. **Review a Fundraiser's Credit History**
   If an investor is interested in any matching bid order, the investor can retrieve a full transaction history of the fundraiser who created the deal. Each bid order includes an identification string of the fundraiser, a sighash. The investor can use the sighash to retrieve the fundraiser's credit history from the blockchain for free.

4. **Create Investment Offers**
   If the investor likes the credit history of the fundraiser, he can create an offer. The offer information includes a set of one add order and a matching bid order. The investor will pay Creditcoin as a transaction fee to the Creditcoin network to create the offer. If the fundraiser likes the offer, he will send a deal to the investor.

II. Make an Investment

If an investor likes a deal, he can accept it by registering the investment transaction on the Creditcoin network.

1. **Transfer the Investment to the Fundraiser**
   A deal includes where the fundraiser would like to receive the investment. Note that the investment transfer happens on another blockchain (e.g., Bitcoin or Ethereum). The investor may pay a transaction fee on that blockchain, but not on the Creditcoin network.

2. **Complete the Deal**
   Once the investment transaction is confirmed on the blockchain, the investor can make the investment official by registering the transaction ID to the Creditcoin

network. The investor will pay Creditcoin as a transaction fee to the Creditcoin network to complete the deal.

III. Collect a Repayment

A fundraiser can repay the full amount to finish the loan-cycle without the involvement of the investor. However, an investor may choose to exempt a partial amount of the repayment.

1. **Negotiate for an Exemption**
   In some cases, a fundraiser may not be able to repay the full amount but a part of it. If so, the investor may choose to accept partial repayment since it is better than nothing. The investor and the fundraiser can communicate outside of the Creditcoin network and negotiate for an exemption. Since the negotiation happens outside of the blockchain, it does not cost any Creditcoin.

2. **Accept a Partial Repayment**
   Once the investor agrees to exempt a loan, the fundraiser will have to repay the rest of the loan. Just like the investment transaction, the repayment transaction also happens on another blockchain (e.g., Bitcoin or Ethereum). After the repayment transaction is confirmed on the blockchain, the investor can finalize the exemption by registering the repayment transaction ID on the Creditcoin network The investor will pay Creditcoin as a transaction fee to the Creditcoin network to register the repayment transaction ID.

IV. Transfer a Bond

An investor may choose to transfer the ownership of a loan, bond, to another account. We call the new account a “collector.” Once a bond is transferred to a collector, the repayment of the loan will be sent to the collector. This allows investors to liquidate their bonds before the maturity of their loans.

1. **Searching for a Collector**
   An investor can find a collector for the bond outside of the Creditcoin network. The blockchain does not support any communication tool for this purpose. Since the search and communication happen outside of the Creditcoin network, it does not cost any Creditcoin.

2. **Searching for a Repayment Order**
   A collector will send a repayment order to the investor to purchase a bond. The investor can search for outstanding repayment orders on the Creditcoin network for free.

3. **Accepting a Repayment Order**
   A repayment order will include payment for transferring the bond. If the investor likes the repayment order, the investor can transfer the bond by accepting the payment. The investor will pay Creditcoin as a transaction fee to the Creditcoin network to accept the repayment order.

Collector's Flow

On the Creditcoin network, a collector is an account that receives the ownership of a loan from another account.

I. Purchase a Bond

A collector can buy a bond from the investor to transfer the ownership of a loan, bond, to his account. Once a bond is transferred to a collector, the repayment of the loan will be sent to the collector. This allows collectors to acquire bonds closer to maturity.

1. **Searching for a Bond**
   A collector can find an investor outside of the Creditcoin network. The blockchain does not support any communication tool for this purpose. Since the search is a read-only process, and the communication happens outside of the the Creditcoin network, it does not cost any Creditcoin.

2. **Create a Repayment Order**
   A collector will send a repayment order to the investor to purchase a bond. The repayment order includes a payment to the investor for the bond. The payment can be in any cryptocurrency supported by the Creditcoin network (e.g., Bitcoin Ethereum, or ERC-20). The collector will pay the Creditcoin transaction fee to the Creditcoin network for creating the repayment order.

3. **Searching for an Accepted Repayment Order**
   The collector can search for accepted repayment orders on the Creditcoin network for free.

4. **Close a Repayment Order**
   After a repayment order gets accepted by the investor, the collector can finalize the purchase of the bond by registering the payment transaction ID. In other words, the collector closes a repayment order. The payment happens on another blockchain, and the collector may have to pay a transaction fee on the blockchain. Once the repayment order is closed, repayment of the loan goes to the new owner - the collector. The collector will pay Creditcoin as a transaction

fee to the Creditcoin network to close the repayment order.

Conclusion

Creditcoin network has been built to support various investment scenarios and assists in decision making and transitioning of the relevant artifacts through their lifecycle.

Introduction

Purpose

This document provides a comprehensive architectural overview of the system, using several different architectural views to depict various important aspects of the system.

Scope

This Software Architecture Document provides an architectural overview of the Creditcoin system developed by Gluwa, Inc. to provide a decentralized credit network.

Overview

The Creditcoin system is a decentralized credit network for investors and borrowers and to facilitate efficient and safe transactions between parties. A special cryptocurrency named Creditcoin is used as an aid in performing transactions and incentivizing parties to support, develop and expand the network and keep it operational.

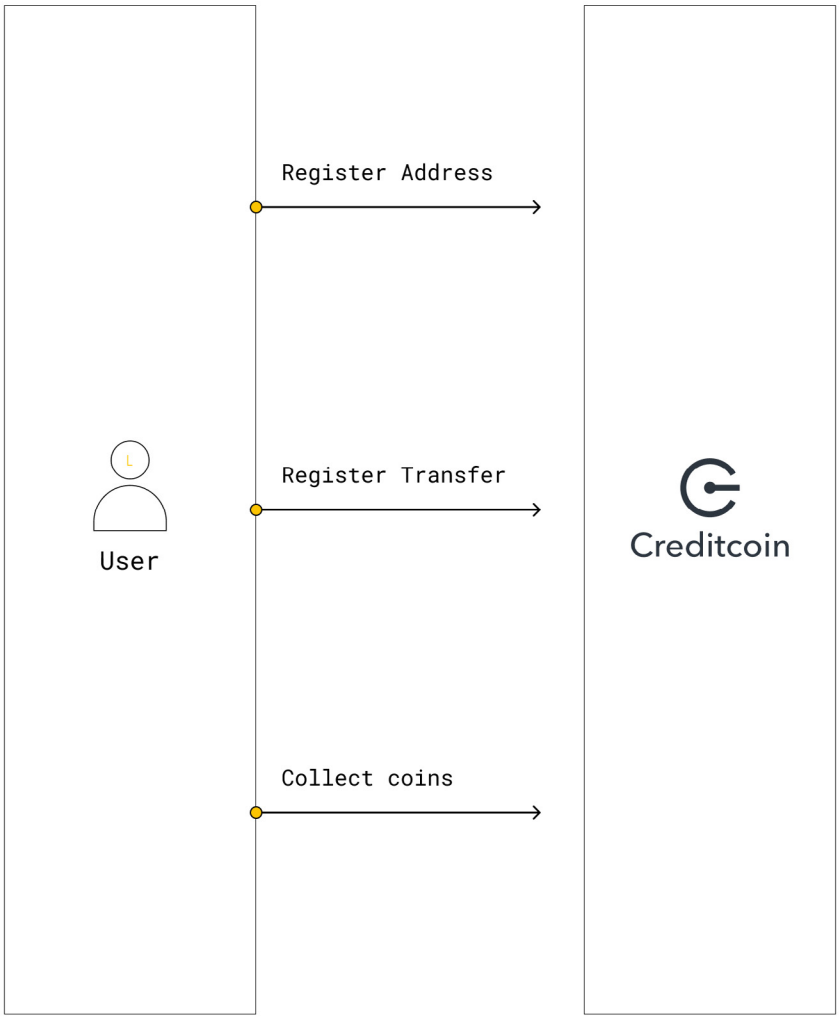
Architectural Goals and Constraints

1. To support decentralization, the network is based on blockchain (distributed ledger) technology.
2. To reduce the work required to build a robust and trustworthy foundation for the network, an open source blockchain project was selected based on feature completeness and ease of configuration and modification (Hyperledger Sawtooth).
3. The network supports the booking of investment and borrowing orders in a credit market order book for which canceled or outdated orders are of little interest.
4. The network supports matchmaking, communication between involved parties, and deal booking. The latter is stored permanently on the ledger and may be used for dispute resolution and credit history verification.
5. The network supports interoperability with other cryptocurrencies through a generic gateway that may be customized for use with a particular cryptocurrency.
6. The network uses a special consensus algorithm to incentivize validators and prevent network abuse.
7. All performance, bandwidth and storage requirements were taken into consideration to develop the architecture.

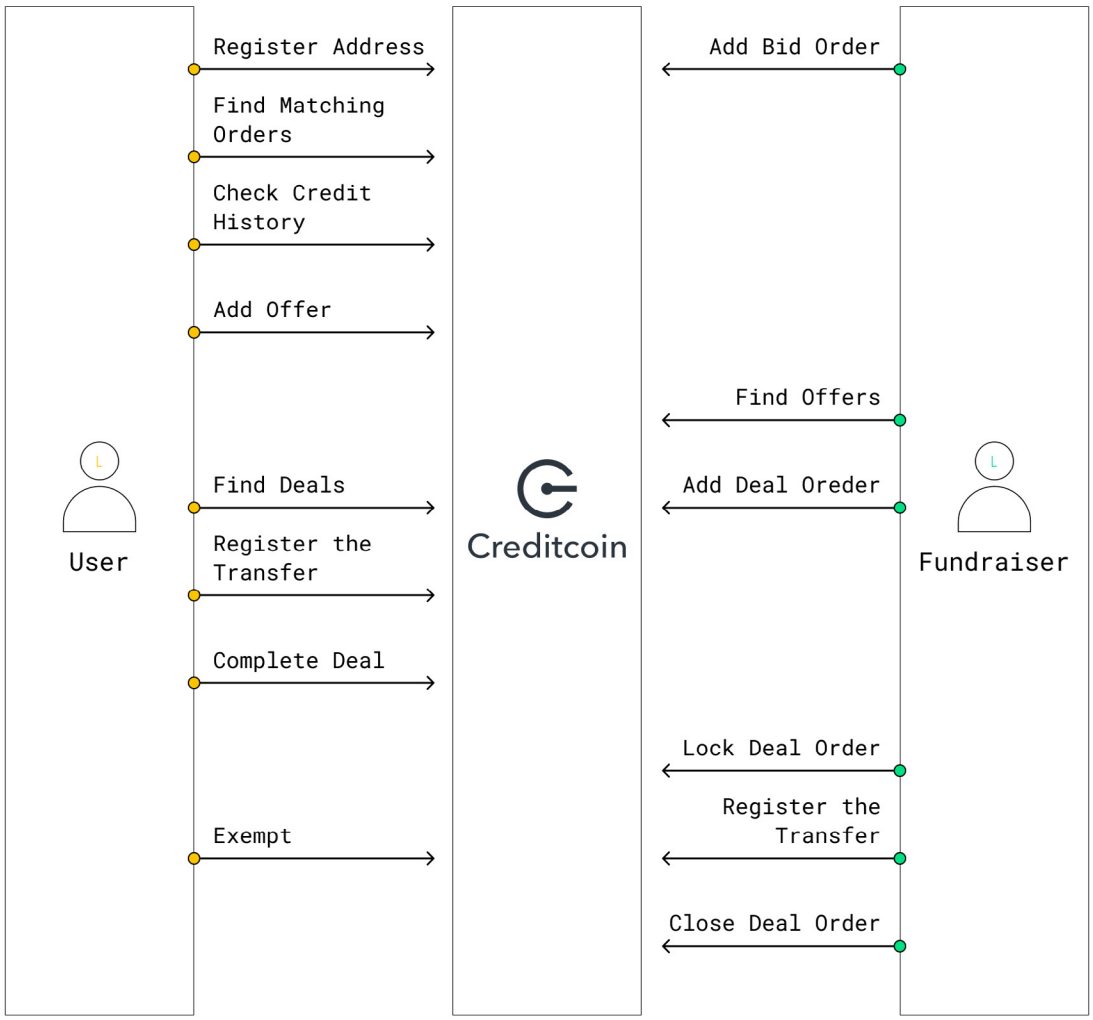
Use Cases

The figures below summarize the various use cases.

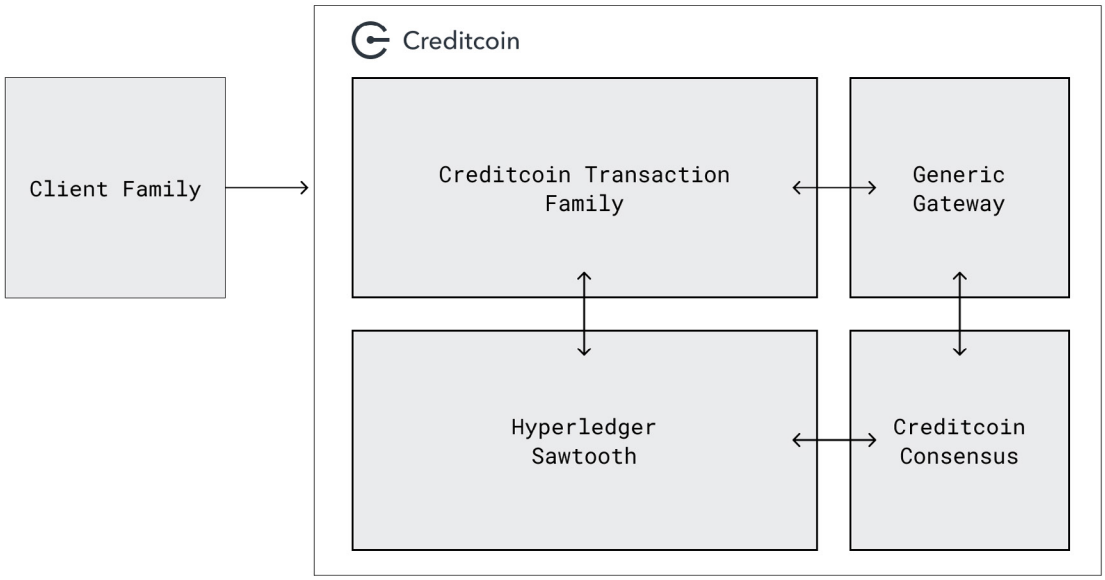
User Use Cases



Investor and Fundraiser Use Cases



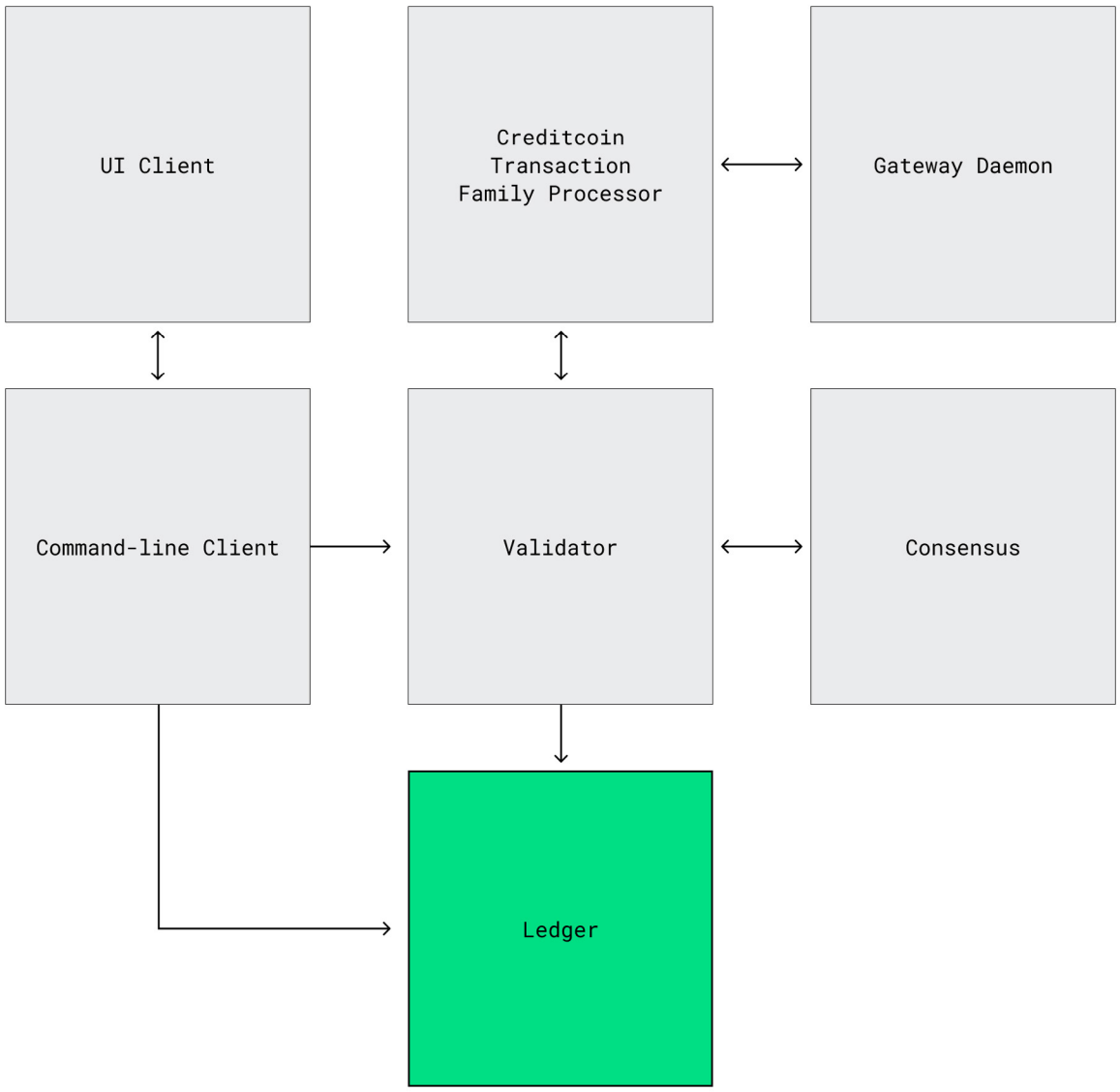
Subsystems and Layering



The Creditcoin system is built on top of the Hyperledger Sawtooth project, which provides an implementation of a distributed ledger and interoperation between distributed components of the network. The system provides:

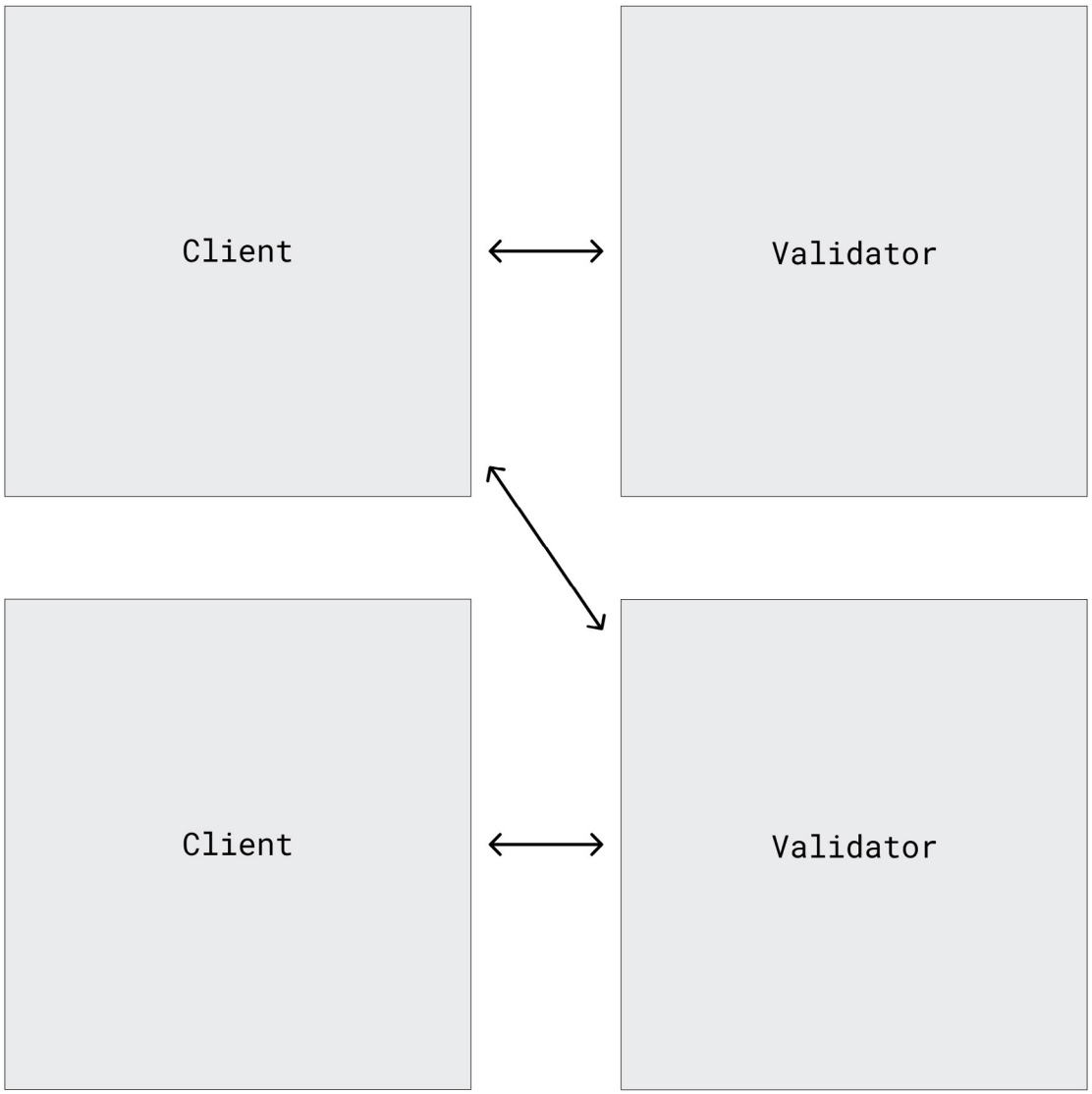
1. An implementation of the Creditcoin transaction family—a group of operations or transaction types allowed on the ledger—which supports all required operations.
2. An implementation of a consensus algorithm to support the requirements, in this case Proof-of-Work.
3. An implementation of a generic gateway to interconnect with other cryptocurrency networks, such as Bitcoin, Ethereum, etc.
4. A family of client applications was developed for testing and use by end users, which includes a command-line client, a UI client and simulation and load testing clients.

Processes



Each validator node runs a validator, Creditcoin Transaction Family Processor, Settings Transaction Family Processor (stock, not shown in the diagram), and Creditcoin consensus plugin. A gateway process runs to allow communication with other cryptocurrency networks. Client applications send requests to a validator to perform operations on data for a given transaction family; the validator then dispatches the request to a relevant processor. The processor submits the transaction to the ledger. Clients read the current state of data that has been made persistent by recording it on the ledger.

Deployment



In the final distributed system, client applications can connect with validators across local or global TCP networks. Any validator accepts transactions from one or more clients and clients sends transactions to one or more validators.

Implementation Notes

The initial validator network operates on Ubuntu boxes running in Azure. The transaction families were developed and tested on Windows 10, but also runs on Ubuntu. The development language for Creditcoin transaction family is C++; clients are implemented in C#, while the consensus is implemented in Python.

Configuration Notes

The initial setup runs with a temporary transaction family processor that sets up the Creditcoin components on the ledger. The system is configured to run a predefined set of transaction family processors.

Creditcoin Workflow

This document covers a step-by-step guide on how you can use the Creditcoin network and Creditcoin through a command-line client. Refer to the User Flow section to understand the what role each command plays in a loan-cycle.

Gluwa Creditcoin is the official implementation of the Creditcoin protocol by Gluwa, a member of the Creditcoin Foundation. The implementation includes a command-line client for Creditcoin users to interact with the network.

Note that you need to pay a transaction fee in Creditcoin per each command.

Exchange G-CRE to CTC

To start participating in Creditcoin network users need to register their Ethereum addresses and exchange their G-CRE (Gluwa Creditcoin Vesting Token) to Creditcoin (CTC). G-CRE is an ERC20 token used for initial distribution to token sale buyers, Gluwa, and the foundation.

Register Ethereum Address

G-CRE is transferred from ERC20 by running the 'exchange()' method on the Creditcoin smart contract and collecting the coins on the Creditcoin network.

In the following command:

$ creditcoin RegisterAddress ethereum address main

'ethereum' is the blockchain, 'address' is a user's ethereum address, and 'main' is the network id.

Show Address ID of the Registered Address

To find out the address id for the registered address a user can run the following command:

$ show Address 0 ethereum address main

Where 0 is the sighash that identifies the interactive user and other parameters are the same as provided for registration.

Exchange G-CRE to CTC

Using the Registered Ethereum Address

Now the user can run the following command:

$ ethereum CollectCoins addressId amount

Where 'addressId' is the result of the previous show command and 'amount' is the amount not exceeding the amount of ERC20 tokens on Ethereum.

Using the Exchange() Transaction On G-CRE Smart Contract

Alternatively, the user can manually call 'exchange()' on Creditcoin Ethereum smart contract, write down the transaction id and call the following command:

$ creditcoin CollectCoins addressId amount transactionId

Review the Updated CTC Balance

Now the user can display the Creditcoin balance with the following command:

$ show Balance 0

Where 0 identifies the interactive user.

Alternatively, if the user knows a sighash of another user, the user can run the following command:

$ show Balance eccd3cc374e641b8fabf12eff4d5e3506e...

Create Investment Orders

Create an Ask Order

An investor can add an AskOrder with the following command:

$ creditcoin AddAskOrder addressId amount interest maturity fee expiration

Where 'addressId' is an id of an address record registered by using 'creditcoin RegisterAddress' command, 'amount' is the amount for investing in the blockchain identified by the 'addressId', 'interest' is the interest rate, 'maturity' - is a number of blocks to calculate the resulting interest, 'fee' is a loan fee and 'expiration' is a number of blocks the order is valid for.

Create a Bid Order

A fundraiser can add a BidOrder with the following command:

$ creditcoin AddBidOrder addressId amount interest maturity fee expiration

Search for Matching Orders

An investor can search for matching orders with the following command:

$ show MatchingOrders 0

Where 0 is a 0-sighash

For each matching pair of orders, the output will be a list of pairs of the respective order ids:

askOrderId bidOrderId

Review Credit History of the Fundraiser

An investor can check the fundraiser's credit history with the following command:

$ show CreditHistory sighash

Where 'sighash' is the identifier of the fundraiser

Create Investment Offers

Create an Offer

An investor can create an offer with the following command:

$ creditcoin AddOffer askOrderId bidOrderId expiration

Where 'askOrderId' and 'bidOrderId' are the output of the previous 'show MatchingOrders' command and 'expiration' is the number of blocks the offer is valid for.

Search for Offers

A fundraiser can check for current offers with the following command:

$ show CurrentOffers 0

Where 0 is a 0-sighash. The output is a list of offer ids.

Create Deals

Create a Deal Order

A fundraiser can add a DealOrder with the following command:

$ creditcoin AddDealOrder offerId expiration

Where 'offerId' is an id of an offer previously displayed by 'show CurrentOffers' command.

Search for Deals

An investor can check for new deals with the following command:

$ show NewDeals 0

Which displays a list of dealIds for the investor.

Register an Investment Transfer

To complete a deal Investor has to register a transfer with the following command:

$ ethereum RegisterTransfer 0 orderId

Where 'orderId' is an id of a deal previously displayed by 'show NewDeals' command.

This command will create an Ethereum transaction sending the amount of Ether specified in the BidOrder to the address specified in the BidOrder from the address specified in the AskOrder.

Note that the actual transfer can happen elsewhere as soon as it satisfies the requirements, but it still has to be registered with Creditcoin, there is a special form of RegisterTransfer for that - creditcoin RegisterTransfer gain orderId txId (note it's not etherium but creditcoin command and takes additional parameter txid).

Complete a Deal

An investor can complete a deal with the following command:

$ creditcoin CompleteDealOrder dealOrderId transferId

Where 'dealOrderId' is the deal being completed and 'transferId' is the loan transfer.

Lock a Deal

To close a deal Fundraiser has to lock the deal first with the following command:

$ creditcoin LockDealOrder dealOrderId

Where ‘dealOrderId’ is the deal being closed.

Close a Deal

A fundraiser can close a deal with the following command:

$ creditcoin CloseDealOrder dealOrderId transferId

Where ‘dealOrderId’ is the deal being closed and ‘transferId’ is the repayment transfer.

Exempt Loans

An investor can exempt a loan with the following command:

$ creditcoin Exempt dealOrderId transferId

Where ‘dealOrderId’ is the deal being exempted and ‘transferId’ is a partial repayment transfer.

Transfer Loans

A third party (collector) may offer to transfer the loan ownership by creating a “RepaymentOrder” using the following command:

$ creditcoin AddRepaymentOrder dealId collectorAddressId amount expiration

Where ‘dealId’ is the id of the deal order, ‘collectorAddressId’ is the address of the new owner, ‘amount’ is the amount offered for transferring the loan.

Repay Loans

Search for Repayment Orders

An investor can check for new RepaymentOrders using the following command:

$ show NewRepaymentOrders 0

The output is a list of ids.

Accept Repayment Orders

An investor can accept a RepaymentOrder using the following command:

$ creditcoin CompleteRepaymentOrder repaymentOrderId

Search for Accepted Repayment Orders

A collector can check for accepted RepaymentOrders using the following command:

$ show CurrentRepaymentOrders 0

Close Repayment Orders

A collector can close the RepaymentOrder by registering a transfer and using the following command:

$ creditcoin CloseRepaymentOrder repaymentOrderId transferId

Demonstration

https://www.youtube.com/watch?v=qpvVrChDzZE

Please refer to the live demonstration of the Creditcoin command-line client above for more information.

Citations

Aaron hay, *"Crypto and Network Effects"*, Accessed (25/05/2021): https://medium.com/coinmonks/crypto-and-network-effects-e66e69e754d3

Babajide Fowowe, *"Access to finance and firm performance: Evidence from African countries"*, Review of Development Finance, Vol. 7 No. 1, 2017, pp.6-17

Berrak Büyükkarabacak & Nevan Valev, *"Credit Information sharing and banking crises: An empirical investigation"*, Journal of Macroeconomics, Vol. 34, No. 3, pp.788-800, 2012.

Catalini, Christian, and Joshua S. Gans. 2016. *"Some Simple Economics of the Blockchain."* NBER Working Paper No. 22952. Accessed (21/05/2021): http://www.nber.org/papers/w22952.

Catherine Tucker, Christian Catalini, *"What Blockchain Can't Do"*, Harvard Business Review, 2018, Accessed (28/05/2021): https://hbsp.harvard.edu/tu/4167ec3d

Cathy Barrera, *"The Blockchain Effect: Network Effects without Market Power Costs"*, Accessed (24/05/2021): https://medium.com/mit-cryptoeconomics-lab/the-blockchain-effect-86bd01006ec2

Convergences, *"Global Microfinance figures: What are the trends?"* , Accessed (04/06/2021): https://www.convergences.org/en/119115/

Ernst Fehr, and Christian Zehnder, *"Reputation and Credit Market Formation: How Relational Incentives and Legal Contract Enforcement Interact"*, IZA Institute of Labour Economics, Discussion Paper No. 4351, 2009

Fran Casino, Thomas K. Dasaklis, Constantino Patsakis, *"A systematic literature review of blockchain-based applications: Current status, classification and open issues"*, Telematics and Informatics, Vol. 36, pp. 55-81, 2019

Maik Dierkes, Carsten Erner, Thomas Langer, Lars Norden, *"Business credit information sharing and default risk of private firms"*, Journal of Banking & Finance, Volume 37, Issue 8, 2013, pp.2867-2878

MIX, *"2015 Global Outreach & Financial Performance Benchmark Report"*, Accessed (04/06/2021):https://www.themix.org/publications/2015-global-outreach-and-financial-performance-benchmark-report

OECD, *"Facilitating Access to Finance, Discussion Paper on Credit Information Sharing"*, 2010.

OECD, *"New Approaches to SME and Entrepreneurship Financing: Broadening the Range of Instruments"*, 2015

Reportlinker, *"Global Microfinance Industry"*, 2021, Accessed (03/06/2021): https://www.reportlinker.com/p05799111/?utm_source=GNW

Samuel Fosu, Albert Danso, Henry Agyei-Boapeah, Collins G. Ntim, & Emmanuel Adegbite, *"Credit Information sharing and loan default in developing countries: the moderating effect of baking market concentration and national governance quality"*, Review of Quantitative Finance and Accounting, pp.55-103, 2020

SIFMA, *"2020 Capital Markets Fact Book"*, 2020, Accessed (24/06/2021): https://www.sifma.org/wp-content/uploads/2020/09/US-Fact-Book-2020-SIFMA.pdf

SME Finance Forum, *"MSME Finance Gap"*, Accessed (22/05/2021): https://www.smefinanceforum.org/data-sites/msme-finance-gap

Svetlana Andrianova, Badi Baltagi, Panicos Demtriades, & David Fielding, *"Why do African Banks Lend so Little"*, Oxford Bulletin of Economics and Statistics, Vol. 77, No. 3, pp.339-359, 2015

Tullio Jappelli, and Marco Pagano, *"Information Sharing, Lending and Defaults: Cross country Evidence"*, Centre for Studies in Economics and Finance, Working Paper No. 22, 1999

World Bank, *"Domestic Credit to private sector (% of GDP)"*, Accessed (02/06/2021): https://data.worldbank.org/indicator/FS.AST.PRVT.GD.ZS?locations=NG-US