Equilibrium

#1 decentralized interoperable money market

www.equilibrium.io

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Abstract

This paper introduces a Substrate-based engine on the Polkadot network that lets non-custodial liquidity pools on different blockchains interact with each other and unites them as one cross-chain decentralized lending hub with built-in synthetic assets, advanced price discovery and bailout mechanics. The engine will be running on Equilibrium's DeFi Parachain implementing PoS-consensus with a DeFi-specific fee model and designed to underlie a wide spectrum of decentralized finance applications.

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Equilibrium (noun): A state in which opposing forces are balanced
(Oxford English Dictionary)

1. Current challenges for DeFi

No matter the type of decentralized finance project, the user journey usually starts with locking value in a smart contract. As of this writing, the total value locked in DeFi on various blockchains (including Ethereum, EOS, and TRON) is over $1.172 billion [1]. The number has been floating around this level for a while, and it seems likely that this is due to the infrastructural challenges which have been plaguing DeFi for some time.

This chapter considers the three biggest challenges for decentralized finance, which Equilibrium is working to overcome with its innovations.

1.1. Fragmentation of the DeFi space

The rise of decentralized finance has driven mass creation of DApps and introduced many prominent new concepts and financial models. Some of them were inherited from traditional finance while some are a complete novelty. Among these diverse innovations, the most sustained models include: pooled lending (Compound, Aave), synthetic assets (MakerDAO, Synthetix), margin trading tools (bZx, dY/dX), and exchange protocols (Bancor, Kyber).

Despite their commonality in smart contracts, from an end-user perspective, the DeFi space comprises dozens of scattered applications whose functionality often overlaps with each other. Borrowing ETH on Compound, collateralizing it in MakerDAO to generate DAI, and buying more ETH for DAI on Kyber, requires the end user to interact with three different UIs and to broadcast three separate blockchain transactions. Beyond that, users are forced to monitor their positions on multiple protocols. All together, this scope of maintenance is overwhelming and inefficient for users.

Fortunately, emerging DeFi dashboards (like Zerion, InstaDApp, Argent or DeFisaver) are designed to simplify the user experience by aggregating access to various DApps in a single interface. However, this does not solve the problem of siloed platforms, since most of these interfaces are only compatible with the Ethereum network. The economic models attached to these DApps still exist in parallel, while they could complement each other if they were integrated.

Combining pooled crypto lending that supports a collateral basket by generating synthetic assets and a liquidity cushion for bailouts would result in a more sustainable structure and unite the fragmented DeFi space. This is exactly what Equilibrium is proposing. At the same time, users will be able to access DeFi instruments that they previously used via distinct protocols in one single place.

1.2. Missing cross-chain composability

Things become more complicated when it comes to operations across multiple blockchains. The current lack of seamless cross-chain interoperability forces users to juggle transactions among several networks and switch between separate wallets, each of which holds private keys.

The user flow gets even trickier due to stand-alone peg in/out services. As a result, most users and traders find it more convenient to transfer value between different blockchains using centralized exchanges. However, this is an inherently insecure setup since it requires end users to trust a third party with their funds.

Nonetheless, the bigger issue is that liquidity in existing systems is isolated and limited by the boundaries of underlying blockchain networks. Currently, Ethereum holds a leading position in the field, with various money market, trading, and asset exchange protocols in its ecosystem. The obvious drawback here is that non-ETH based assets cannot be used effectively inside those protocols. Thus, 88% of the ecosystem is still underutilized, while the value of the assets locked in DeFi is dwarfed in comparison to the market cap of the entire crypto space.

Cross-chain communication has thus emerged as a major challenge of decentralized finance: interoperability will bring additional liquidity and asset variety into the DeFi space, opening up possibilities for building DeFi infrastructure — such as multi-currency lending protocols, cross-chain DEX with margin trading, derivative contracts, and liquidity pools.

Interoperability also offers huge potential for further scalability, since the initial system on Equilibrium's parachain is designed to handle all the core logic of the application. The task of connecting a new blockchain comes down to bridging it with the initial parachain and rolling out a simple escrow smart contract in the network that is being connected.

1.3. The problem of liquidations in distressed markets

Another problem of major DeFi protocols is their auction model for bad debt liquidations. The idea of selling collateral at a discount can fail badly as soon as the market starts to crash. It may turn out there are simply no market players willing to buy a rapidly depreciating asset at any discount. It is important to keep in mind that the risk of an undercollateralized loan remains on the system as long as its collateral has not been liquidated. This can result in losses for risk-averse users who hold collateral in the same pool and can even lead to system shutdown.

From recent experiences, we have seen that it is not only market conditions which can adversely affect the auction model. In March 2020, a bottleneck in the Ethereum network amid a transaction storm led to the operational failure of MakerDAO's auctioning system. While most ecosystem participants who meant to participate in auctions could not broadcast blockchain transactions, some of them used this incident to increase transaction costs, bid ridiculously low amounts (almost zero) at $6,000 auctions — and won. These zero-bid auctions resulted in more than $6.5M in losses for the MakerDAO protocol.

Such events can be avoided by setting liquidity cushions for bailouts upfront. This can be achieved by using third party agents (bailsmen) who provide liquidity in advance and earn by securing loans. Distributing risk between lenders and bailsmen works particularly well on interoperable systems, since cross-chain bridges can facilitate the kind of fast action that is required.

2. Equilibrium's cross-chain engine for liquidity pools

Equilibrium is a DeFi hub that consists of a Substrate-based engine on the Polkadot network and designated smart contracts on bridged blockchains that act as non-custodial liquidity pools. The engine enables cross-chain interoperability for the pools and unites them into a decentralized lending platform with advanced price discovery and bailout mechanics.

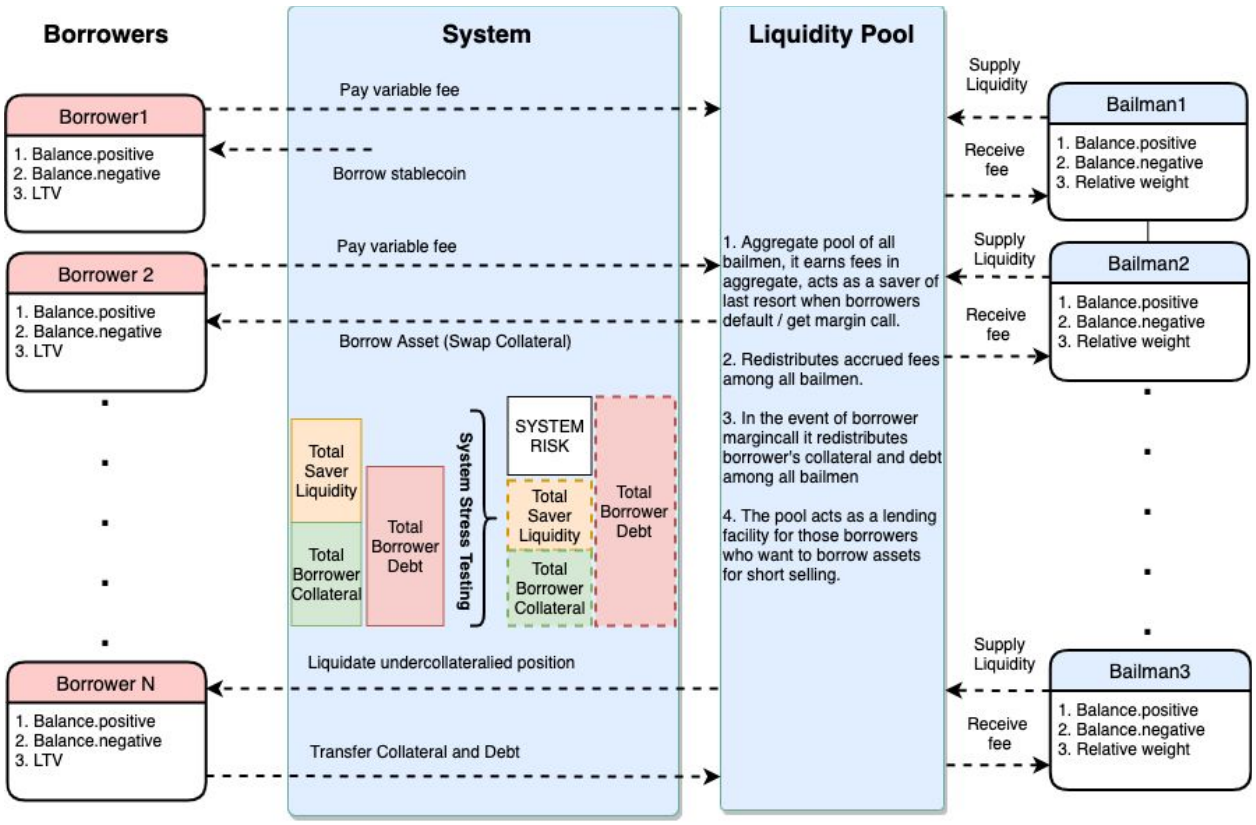
The Equilibrium hub is addressing the three main challenges of DeFi that we outlined in the first chapter. It is eliminating DeFi fragmentation by offering a one-stop-shop which meets the demand of various DeFi users. Thanks to its underpinning technology platform, Equilibrium delivers interoperability out of the box. Its liquidation mechanism provides bailout liquidity that is settled in advance. It thus mitigates the risk that there would be a lack of auction participants to buy out liquidated collateral in case of market turmoil.

2.1. The product and its features

There are three key user roles in the Equilibrium system — lender, bailsman, and borrower.

- Lenders can stake crypto assets and get passive income via pooled lending
- Bailsmen can take on risk by securing loans in the system with their assets and earn additional premiums
- Borrowers can borrow crypto, and generate synthetic assets or decentralized stablecoins — all with automatically defined APR.

Users transact with blockchain networks of their choice, there is no need to match counterparties as is the case in peer-to-peer systems.



2.1.1. Staking

Lenders, bailsmen, collateral providers — all users who provide liquidity on PoS/ DPoS blockchains will be able to earn yield on their assets. The platform introduces a mechanism of risk-free staking, locking tokens into the smart contracts that it uses as “bridges” to other blockchains. These smart contracts in turn can utilize users’ stake for generating additional rewards from the inflation-based economies which are common in proof-of-stake systems. Equilibrium will be distributing such rewards to its users.

One drawback here is that bridge contracts should not use entire crypto asset holdings for staking, since the effective funds lock disallows for timely cross-chain unwrapping or withdrawals. The most optimal solution here will be that Equilibrium will introduce a reserve requirement for occasional withdrawals so users do not experience any delays. The amount of reserves should be sufficient to cover withdrawal demands in stressful market conditions. The required figures will be set after we obtain and extrapolate real figures observed in practice.

To decide which PoS/ DPoS validators or staking protocols will receive staked assets on originating blockchains, EQ token holders will stake their EQ into the governance smart contract and vote for validators or protocols of their choice. The system will then distribute a portion of staking rewards to EQ holders.

2.1.2. Lending

Users can lend out a fraction of their holdings to other users who would like to borrow assets for some purpose, e.g. for selling them short or fulfilling their liabilities with 3rd parties.

One primary difficulty that has to be overcome here involves the depletion of the lendable asset and the inability of lenders to leave at their will when this happens: they must either wait for a sufficient amount of borrowers to bring the asset back to the pool, or for new lenders to add collateral to the pool for lending, or they can instantly unwind their position against the reserves.

This is why we have decided to separate the function of lenders and bailsmen at least on the interface level: bailsmen will have the choice of becoming lenders by setting a corresponding flag when providing cross-chain liquidity. We will track separate aggregates on lendable assets and will set governance-defined limits on the quantities of assets that will be available for borrowing. Bailsmen who become lenders will be entitled to additional system fees coming from users borrowing crypto assets for the purpose of funding or selling short.

Our pricing and risk model remains intact when users borrow a crypto asset or create a synthetic asset. We use negative balances in tokens to reflect borrowing crypto assets other than our stablecoin and to track negative portfolio balances to gauge users' debt levels and system risk metrics.

2.1.3. Bailouts

Lenders may also act as bailsmen, and thereby protect borrowers and earn extra fees. Bailsmen are unified in a single liquidity pool where they share risks and losses. This system design is ideally suited to highly leveraged borrowing -- a necessary feature for any DeFi related ecosystem to grow (think of decentralized margin trading).

2.1.4. Borrowing

Crypto assets carry a volatility risk, so when borrowers use them as collateral, additional collateral is required in addition to paying a fee. We expect borrowers to supply various crypto assets as collateral via cross-chain wrapping and will consider their overall collateral portfolios rather than treating each collateral token separately - a common shortfall of current DeFI behemoths such as MakerDAO and Compound. Each borrower will pay a floating rate fee based on their collateralization ratio, particular portfolio and associated volatility risk.

2.1.4.1. Synthetic assets and decentralized stablecoins

With its architectural approach, Equilibrium is introducing a cross-chain store of value to DeFi. The following is a brief overview of the features that users will be able to enjoy using Equilibrium's solution:

- Users will be able to generate decentralized stablecoins in the blockchain of their choice by supplying collateral in any other blockchain of their choice. E.g. a user could say that

they want to mint stablecoin on ETH blockchain by providing collateral on EOS blockchain, and the Substrate will handle the balance sheet.

- Users will be able to generate synthetic assets of their choice (given that corresponding price feeds are available) and trade them in a decentralized way inside Equilibrium's Substrate.
- The option to count one user's synthetic asset as another user's liability introduces a fractional reserve feature, and allows us to significantly expand or lever the supply of these synthetic assets. This is similar to the kind of fractional reserve banking practiced by the worldwide banking system.
- Synthetic assets may be exchanged easily without the need for an on-chain order book and matching engine. This is basically a swap of one form of asset or liability into another form of asset or liability.

2.1.5. Primary use cases

In addition to issuing decentralized stablecoins, borrowing assets, and bailing out loans, the substrate will also allow us to build additional products on top of it. In what follows, we are outlining the roadmap of Equilibrium's DeFi product hub. It shows how the Substrate ecosystem will grow into a one-stop shop for cross-chain DeFi. Equilibrium's Substrate will be smart-contract enabled and easily allow third party developers to build various DeFi protocols on top of it.

Product	Timeline	Description
Asset exchange	Q1 2021	Transfer-based rules for exchange between positive and negative (borrowed) user balances. This will be a Substrate-native solution built into the balance module which governs how the transfer and exchange rules work within the system.
Margin trading	Q2 2021	This module will allow users to lock their assets as margin for leveraged trading. It will act as a central clearinghouse controlled by bailout and lender pools.
Unified exchange interface	Q3 2021	Lend, borrow, trade wrapped cross-chain assets all from one convenient UI inside

		Equilibrium's Substrate.
Advanced order types	Q4 2021	Stops, trailing stops, stop limit, trailing limit orders will be added to the exchange functionality.
Delta hedging	Q1 2022	Users will be able to hedge their portfolios in and out of stablecoin to preserve their value.
Synthetic assets	Q2 2022	Users will be able to trade derivatives on stocks, commodities, FX and other real assets.

2.1.6. How Equilibrium compares to other projects

None of the currently leading DeFi protocols on the marketcan beat the set of features offered by Equilibrium to ensure overall user value and system stability:

Feature	Equilibrium	Compound	MakerDAO	Synthetix
Cross-chain enabled	Yes (Polkadot native)	No	No	No
Fee token	Built-in decentralized stablecoin	cTokens, converted to underlying collateral	MKR	SNX
Collateral backed	Yes	Yes	Yes	Yes
Borrow stablecoin	Yes	No	Yes	Yes
Borrow assets	Yes	Yes	No	Synthetic assets
Unified liquidity pool	Yes	No, separate money markets for each token	No, separate vaults for different kinds of collateral	Yes
On-chain risk framework	Yes	No	No	No

and stress testing				
Collateralization requirement	110%*	133.33%**	150%	800%***
Liquidation mechanics	Redistribution of debt and collateral within the pool.	Auctions	Auctions	Redistribution of debt and collateral within the pool.
Interest rate pricing	closed-form pricing formula for an infinite-maturity collateralized loan according to the Black-Scholes model	Arbitrary supply-demand formulas for each market.	Arbitrary stability fee set via MKR governance	N/A only system fees for trading, exchanging synthetic assets.
Price discovery	As borrowers take out loans and prices fluctuate, systemic risk can increase. Interest rate pricing adjusts to drive the entire system to the predefined liquidity target set by system governance.	No	No	No

* Can be set lower

** Minimum across all available markets (SAI, DAI, USDC, ETH)

*** The 800% figure comes from the fact that they use their utility token SNX as collateral

2.2. Governance

Governance plays a crucial role in Polkadot's ecosystem. Equilibrium is aware of the fact that final governance mechanisms might change before Polkadot's initial mainnet launch and is monitoring this situation closely. Equilibrium's substrate will strive to support Polkadot's governance model in its entirety.

The following table table describes the launch roadmap of Equilibrium's DeFi parachain in relation to governance and the move towards decentralization. It is based on PolkaDot's roadmap, which is similar.

Step	Description	Approximate timeline
PoA	We will launch our MVP in PoA mode with 5 validators. The chain will allow users to claim their EQ tokens using Ethereum addresses. Users will be able to: ● Transfer EQ tokens within Equlibrium's Substrate ● Collateralize their EQ tokens to borrow assets or stablecoins. ● Provide bail liquidity in EQ tokens. ● Submit their intention to validate or nominate No inflationary rewards will be available at this stage.	Oct. 2020
NPoS	Equilibrium becomes confident in the stability of the network after PoA. After having reached a sufficient number of validator nominations in the PoA phase, the network will transition to Nominated Proof of Stake (NPoS). During this phase, Equilibrium will take a further step towards decentralizing the network by increasing the validator set to 20 active community validator nodes. Equilibrium will use SUDO to initiate the first validator election.	Dec 2020
Governance	After Equilibrium's Substrate reaches the desired number of validators in the set, the Sudo key will enable the governance module suite in Equilibrium's substrate, i.e. the Council, Technical Committee, and public referenda. Once the Council and governance tools are in place, the community will have the ability to effect changes in the system, and Sudo will be removed. During the governance stage, users can run for Council, vote on councilors, vote on referenda or submit a proposal.	Jan 2021

Core Functionality	The governance system will enable lending modules, voting for bridges to key blockchain networks, expanding asset support beyond ETH, EOS and BTC. Governance will enable a fully-functional DEX with margin trading and exotic order type support down the roadmap.	Mar 2021

2.2.1. Management of system parameters

Governance inside Equilibrium's Substrate will be managed using EQ tokens. EQ token holders use their stake to vote on system parameter changes proposed by the community. All changes require a stake-weighted majority to be agreed upon.

There are several system parameters that are subject to change via decentralized governance. The list will grow as the ecosystem develops and matures.

parameter	description
Minimum LTV	The absolute minimum below which no collateralized borrowing may happen. Governs a borrower's maximum risk.
Liquidity target	Shows what fraction of stressed system losses the bailout pool should hold in aggregate. Governs the bankruptcy risk.
Scale bounds	Risk model volatility scaling boundaries.
Fee reserve weight	Shows what fraction of borrower-generated fees goes into the stability fund. Governs the bankruptcy risk.
Asset discounts and/or VAR confidence	Parameters used to stress-test collateral and debt portfolios for upside and downside jump risk.
Borrowing limits	Limits as a fraction of the entire bailout pool supply which will be applicable for borrowing assets. Governs substitution risk.
Supply caps	Defines the maximum allowable collateral asset concentration across the entire system.
EQ limits for bailsmen	Defines the minimum required and maximum allowable weights in a user's portfolio for

	them to become a bailsman and earn fees.

2.2.2. Adding and removing collateral types

The addition of new collateral types involves analyzing asset market liquidity and supply and relates to concentration risk. The function of including new assets as collateral and as lendable assets will be delegated to system governance as well.

Equilibrium uses a top-down free float and bottom-up instant market liquidity approach to gauge the risk of concentration of a particular kind of collateral. The model then generates a single synthetic asset supply cap figure. The supply cap for a given asset is one of the parameters that will be set via governance mechanisms.

2.2.3. Shutdown

This scenario may unwind if all measures for ensuring the stability of Equilibrium's decentralized stablecoin and the entire system's creditworthiness fail, and there are more unhandled liabilities within the hub than there are assets. The system's governance will have the ability to forcefully stop system operation in case it ever reaches this state. Final losses would be covered by Equilibrium's stability pool, which would ensure that the collateral of well capitalized users is returned in full.

2.3. Economic model

Equilibrium's proposed economic model, which is further subdivided into a risk model and a pricing model, revolves around the notion of credit risk. Credit risk is the risk of a loss resulting from the fact that a borrower or counterparty fails to fulfill its obligations under the agreed terms — either because the borrower cannot or does not want to pay. In traditional finance, credit risk is related to almost all types of financial instruments.

When modeling credit risk losses, several important aspects should be taken into account:

- Defaults are relatively rare events compared to market losses. A lack of available data is an issue for both calibrating the models as well as backtesting.
- Correlations between failures have material impact on the final result and should not be underestimated. This is especially true for the crypto space where different assets display high correlations to dominant market assets such as BTC.
- Portfolio concentration risk should be taken into account.
- Loss distribution has fat tails and is not symmetric.

Credit risk models can be subdivided into two broad categories:

Structural models: These models assume that a default can be explained by a specific trigger point, for example it can be caused by a decrease in asset value below some threshold (i.e. the value of debt). The value of assets itself is modelled as a stochastic process.

Reduced-form models: These models assume that defaults are driven by default intensity. No specific trigger event is assumed, but the default intensity (or default rate) might depend on changes in external factors. The relationships are estimated using historical data and econometric models.

The entire system design of Equilibrium's collateralized and decentralized store of value dictates that we should use the Structural approach, as it more closely reflects the current system architecture and does not rely on heavy backtesting and historical data (which the emerging DeFi space naturally lacks).

2.3.1. Risk model

Synthetic assets or decentralized stablecoin will continue to be stable in value if borrowers have either excess collateral or if the liquidity pool is sufficiently capitalized. Therefore, our smart contract models the capitalization of the liquidity pool as a critical priority. Equilibrium utilizes a methodology similar to SEC's Theoretical Intermarket Margining System (TIMS) [2] used for portfolio margin calculations by qualified US investors. The idea that margin should be set to the maximum loss the portfolio would incur under adverse market scenarios underpins this methodology.

Initially, the stress model will involve parametric calculations of collateral and debt pools under different market conditions. Naturally, when performing statistical tests such as Value at Risk, the following complications arise: Given the sample distribution of returns available to us, what is the best distribution fit of the left tail and how to account for sample bias? A sample of discrete interval collateral returns is only one sample drawn from the actual law that governs collateral return, so how do we account for parameter uncertainty?

Equilibrium's roadmap entails more complicated, non-parametric methods for portfolio stress-testing to answer these questions. One of the approaches we will consider is a decomposition of portfolio risk to model the dependence structure among the assets and to see if the risk contributions of various portfolio components are significantly different. We will use research outlined in [3] for these purposes.

2.3.1.1. Liquidation mechanics

Borrowers' losses are distributed across the entire bailout pool. If the value of a collateral portfolio falls below the value of a debt portfolio for a given borrower, then liquidation is triggered. A borrower's collateral and debt are redistributed among bailsmen across the entire pool and every bailman is given his share of collateral and debt, based on his relative share of the entire bailout pool.

We will use relative portfolio weights initially (e.g. a bailsman with 10% of the entire bailout portfolio weight will be given 10% share in user collateral and in user debt respectively) and at later product stages, we will migrate to more robust measures such as risk weighting.

Further, if the entire bailout pool becomes insolvent (e.g. the value of liabilities exceeds the value of assets), the stability fund comes into play and processes unhandled liabilities from its holdings.

As an additional safety measure, Equilibrium also uses classical liquidations: Borrowers' collateral is auctioned off at a discount to collect required liabilities. Auctions will support EQ tokens as well as several others which will be decided by Equilibrium's governance.

2.3.1.2. Stability Fund

In the final instance, system solvency will be guarded by the Stability Fund — the system's fourth line of defence after overcollateralization, bailouts, and auction liquidations. This is a kind of "insurance policy" that guarantees Equilibrium's system recapitalization in case of extraordinary market events that may drain the system's bailout pools and prevent auctioning.

At first, Equilibrium will use its own capital to establish the Stability Fund just as we have already done on the EOS blockchain, for which we have allocated more than $12M in reserves (learn more here this article). Thereafter, the Fund will continually be replenished by part of the fees generated from borrowers' activities.

2.3.2. Pricing model

The pricing framework is an integral part of the cross-chain collateralized lending and borrowing system. The pricing problem confronts both borrowers and lenders. Associated research on this was pioneered by Xia and Zhou (2007) [4]. They derived a closed-form pricing formula for an infinite-maturity stock loan by solving the related optimal stopping problem according to the Black-Scholes model.

The model takes the risk free interest rate, the loan rate, collateral volatility, potential dividend payments, and the initial debt as its parameters. It is relevant only if the fee rate is higher than a risk free interest rate. It leads to an elegant solution for the interest rate offered to borrowers based on the position collateralization ratio and collateral volatility

As collateral price and volatility change over time, the interest rate charged to borrowers is adjusted using the pricing model — e.g. borrowers pay a floating premium rate. Premiums adjust inversely proportional to collateralization levels and proportional to the level of collateral portfolio volatility.

Once we start accounting for the critical LTV level with continuous monitoring, then the structure changes, and the Xia and Zhou model does not apply. In reality, the barrier monitoring is discrete (on-chain rate update intervals), and the collateral does not behave like a gaussian. It would be best to model the collateral price dynamics with a Jump diffusion process.

Adding margin call and liquidation turns the American option into an down-and-out American barrier option. The penalty for not posting collateral when the price drops below the critical LTV would be included in our adaptation of the Ekstrom model [5].

Equilibrium will further consider pricing with jump risk and build on the hyper-exponential jump

diffusion (HEM) and/or the double exponential jump diffusion model (DEM) [6], and/or the jump-to-default extended constant elasticity variance model (JDCEV), [7]. Pricing models will consider infinite horizon loans similar to the initial model.

2.3.3. System Fees

System fees are those fees which borrowers pay when taking on liabilities, be that decentralized stablecoin generation, synthetic asset creation and borrowing, or borrowing of other crypto assets for funding or trading purposes. These fees are variable and depend on individual borrower portfolio constituents, volatility and collateralization as described in a previous section.

System fees will be redistributed among validators and bailsmen. The proportion of the system fees which each group gets is a dynamic coefficient which will largely depend on the amount of debt in the entire system in relation to average daily transaction volumes.

For example, if transaction volumes are low, validators will get an increased fraction of system fees to cover possible shortfalls. On the other hand, if transaction volumes are high relative to total system debt levels, validators will get an ever diminishing fraction of system fees. The balance point depends on the initial ratio of total debt to avg. daily trx volume (the fee ratio), which in turn depends on the actual trx fee percent we set, as well as the average borrowing rate payable by borrowers and the share of system fees attributable to validators.

To drive the fee ratio to the “indifference target” (where validators make no economic distinction between earning trx fees and system fees), we will dynamically adjust the validator share of system fees based on the median fee ratio calculated for the past 24 hours.

3. Equilibrium’s DeFi parachain

Equilibrium will build its chain as a standalone blockchain using substrate technology, and when Polkadot goes live with its v2, it will become a parachain on Polkadot and enable interoperability for Polkadot’s ecosystem participants and assets, thus providing valuable infrastructure to the broader Polkadot audience for building dApps.

3.1. Polkadot substrate

The Substrate is a blockchain development framework with a completely generic State Transition Function (STF) and composable components for consensus, networking, and configuration.

The Substrate is a core component of the Equilibrium project. Equilibrium will create its own custom DeFi blockchain using the Substrate core. The primary modules will include:

Parameter	MVP	Beta
Proof	PoA	NPoS

Initial number of validators	5	20
Target number of validators	20	20
Block time	6 secs (maybe less after tests)	6 secs (maybe less after tests)
Transaction fee	Standard in EQ tokens with balance adapter	Standard in EQ tokens with balance adapter
Governance	SUDO	Decentralized governance model using EQ tokens
Contracts	Ink	Ink
Consensus	Aura	Babe
Finality	Grandpa	Grandpa
Timestamp	Standard (needed for oracle and fee)	Standard (needed for oracle and fee)

3.2. Consensus

Consensus is a method for coming to agreement over a shared state in a decentralized network. In order for the blockchain to confirm transactions and move forward, all nodes in the network must agree and come to consensus. This is the way that the nodes in a decentralized network are able to stay synced with each other.

During the MVP stage, Equilibrium's Substrate will operate with a type of PoA consensus called AURA, which is provided out of the box by Polkadot. This is a relatively simple algorithm where time is divided into discrete steps of a certain length, and at each step, only one validator is allowed to produce blocks. It is misbehavior to produce more than one block per step, or to produce a block out of turn. Finality is achieved using a simple majority vote and adheres to the relation: 2f + 1 <= n, where f is the number of faulty nodes and n is the total number of nodes. This relationship implies that faulty nodes cannot finalize blocks by themselves.

At the Beta stage Equilibrium will migrate to the BABE / GRANDPA consensus and finality to algorithms. The hybrid consensus stems from the need to provide both probabilistic and provable finality as described in detail in Polkadot's documentation. This is a NPoS consensus rather than the PoA used in our MVP, and will require EQ staking, rewarding and punishing both Nominators and Validators in EQ tokens.

3.3. Nominators and Validators

At later product stages, Equilibrium will utilize Polkadot's native staking mechanics and will adhere to a system of validators and nominators. Since the number of validators within Equilibrium's Substrate will likely be limited, most of the users who will stake EQ will be nominators. Nominators do not perform any critical system work or maintenance, but they too may be slashed in case the validator they nominated misbehaves.

In Proof-of-Stake (PoS) networks such as Polkadot, there will be natural competition between assets being used in staking (for yields) and assets being invested in DeFi (for returns). The current inflationary model for Polkadot's projects is 10% yearly inflation and ~20% annual return. EQ inflation has to be much lower to equilibrate the rate of returns from staking and using EQ in DeFi. Current estimates based on our valuation models suggest inflation numbers around 2.5% a year.

3.4. Fee model

There are two main sources of fees inside Equilibrium's Substrate: transaction fees and fees that borrowers pay for borrowing (system fees). In order for Equilibrium's parachain to function smoothly, there should be an incentive high enough for validators to run the network. Equilibrium is aware of the fact that transaction fees alone will not provide this incentive, at least initially, since the parachain will grow gradually and there will not be many transactions in the beginning.

This is why we adhere to a combined fee approach where validators will receive transaction fees and a fraction of system fees. As the parachain grows and the average number of transactions increases, validators will get an ever diminishing share of system fees, and at some point, will be entitled only to the transaction fees.

3.4.1. Transaction fees

Polkadot has developed a very sophisticated fees model, where actual transaction fees depend on predefined resource usage limits, which are in turn calculated by modeling the blockchain's behaviour with simulations for every transaction type. There are also fast and slow adjusting mechanisms depending on the network's throughput and block saturation levels. Equilibrium will adhere to this model and will perform all necessary tests and measurements as soon as it finalizes its parachain business logic. In the beginning, we will go with a simple fixed fee as a percentage of the transaction/ transfer amount.

Using the pricing and risk models outlined in this document, we can gauge the expected fee amounts given the trx volume and debt levels, and make some assumptions about collateral volatility and the overall system LTV ratio. The following chart, in which we assume 5 validators

in the system, should give the reader an idea of how this works:

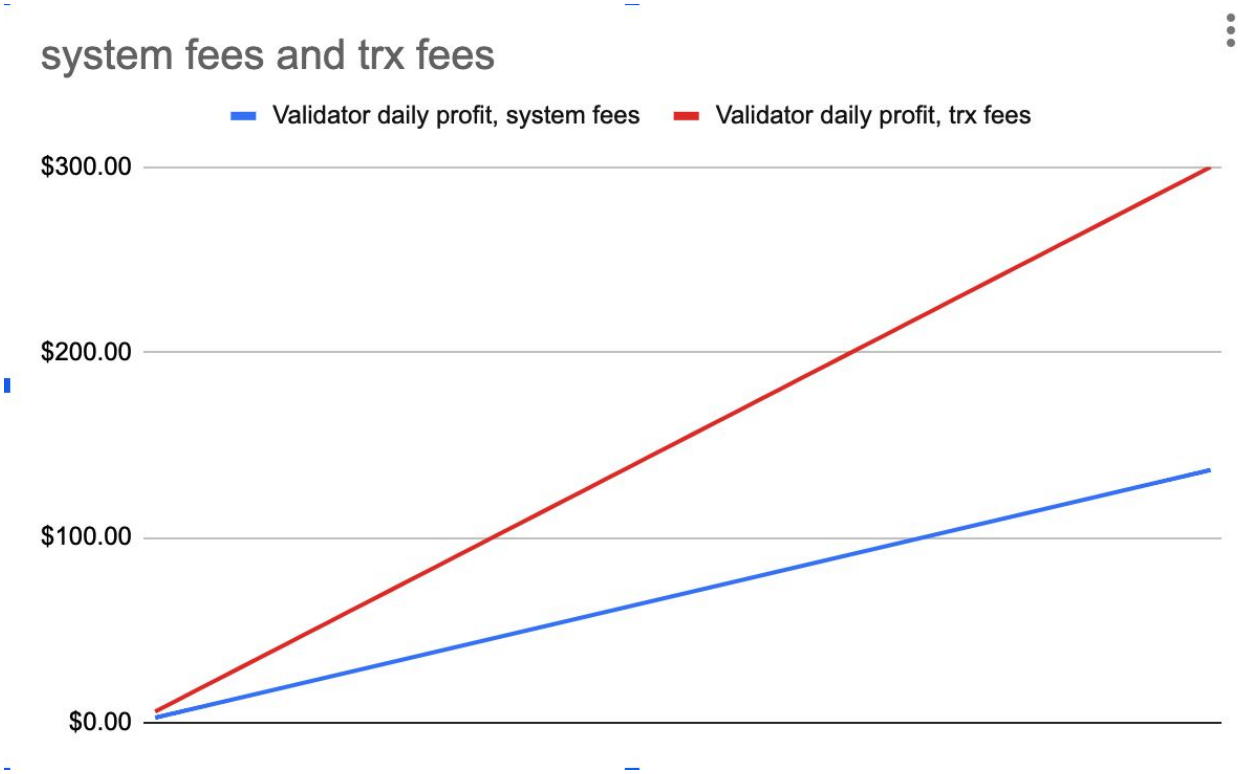


Fig.1 Validators get 20% of system fees under 2.5% average rate assumption where total system debt varies from 1M to 50M. Validators get 0.1% of trx volume fees where trx volume varies from 100K to 5M a day.

We are aware of the fact that these assumptions may be unrealistic, especially given trx volumes and the debt levels considered, but they give you an idea of the fact that trx fees outpace system fees when the volumes grow. To match the slopes of the two lines on the chart above, validators would need to get as much as 40-50% of system fees, which is unreasonably high, given the fact that we want to attract bailsmen with appealing returns on their stakes. As we mentioned earlier, there will be an adjusting mechanism in place to make sure that validators earn a competitive reward for maintaining the blockchain's integrity.

4. Equilibrium's Token (EQ) Economy

The EQ token is Equilibrium's core utility asset, widely used within products built on top of it. EQ tokens grant access to many of these products' features and governance powers. They are used for paying fees, accessing liquidated cryptocurrency collateral, voting for block producers, and managing the framework.

4.1. Transaction fees

Substrate resources such as storage and computation are limited. Transaction fees prevent individual users from consuming too many resources. Equilibrium utilizes Polkadot's

weight-based fee model, where fees are charged prior to transaction execution; once the fee is paid, nodes execute the transaction.

4.2. Participation in bail liquidity provision

In order for any willing party to start earning system fees, they will need to post some liquidity to the bailsman pool to safeguard the system in the event of adverse market movements. The requirement to participate in this pool will be set as a minimum deposit in EQ tokens (expressed as a fraction of a user's portfolio). There will also be a cap on the maximum weight of EQ in a portfolio of any particular bailsman to mitigate the risk of concentration. The actual values will be set by system governance and the initial values will be 0% for minDeposit and 20% for weightCap.

4.3. EQ staking

In order for the platform to function and allow for valid transactions to be carried out across different products, Equilibrium will rely on EQ token holders to play active roles. Participants stake EQ to perform these functions.

The staking of EQ tokens acts as a disincentive for malicious participants who are punished by the network by getting their EQ tokens slashed. The EQs required to participate in the network vary depending on the activity which is being performed, the duration the EQs will be staked for, and the total number of EQs staked.

Staking EQ tokens will play another important role within the system: EQ stakers will have the ability to decide where the PoS consensus based assets in their native blockchains should be staked to earn additional rewards from staking. This is done by simple majority voting and will require threshold participation to come into effect.

4.4. Governance

Another important function of EQ is to entitle holders to control of the governance of the platform. Functions that are covered within governance include determining the amount and weight of fee distributions, upgrades and fixes to Equilibrium's parachain.

Equilibrium will utilize Polkadot's native approach to system governance by proposing referenda and subsequent voting with a voting timetable, tallying, adaptive quorum biasing, and voluntary locking mechanisms in place.

4.5. EQ demand mechanism

To incentivize demand for Equilibrium's utility token and to allow for earnings which will cover future operational expenses, the constant part of the system fee will be put aside into a separate exchange pool, and the EQ received from these operations will flow into the Equilibrium foundation pool and be used to cover the R&D and operational costs of the team.

5. Technical implementation

Polkadot has developed a substrate technology to facilitate the ease of creation of custom blockchains. The substrate comes with everything one needs to create one's own blockchain. The substrate's pallets easily enable the creation of blockchain-specific customized logic. Some of the benefits of using a substrate technology --which are also the reasons why Equilibrium is building one of its own -- include:

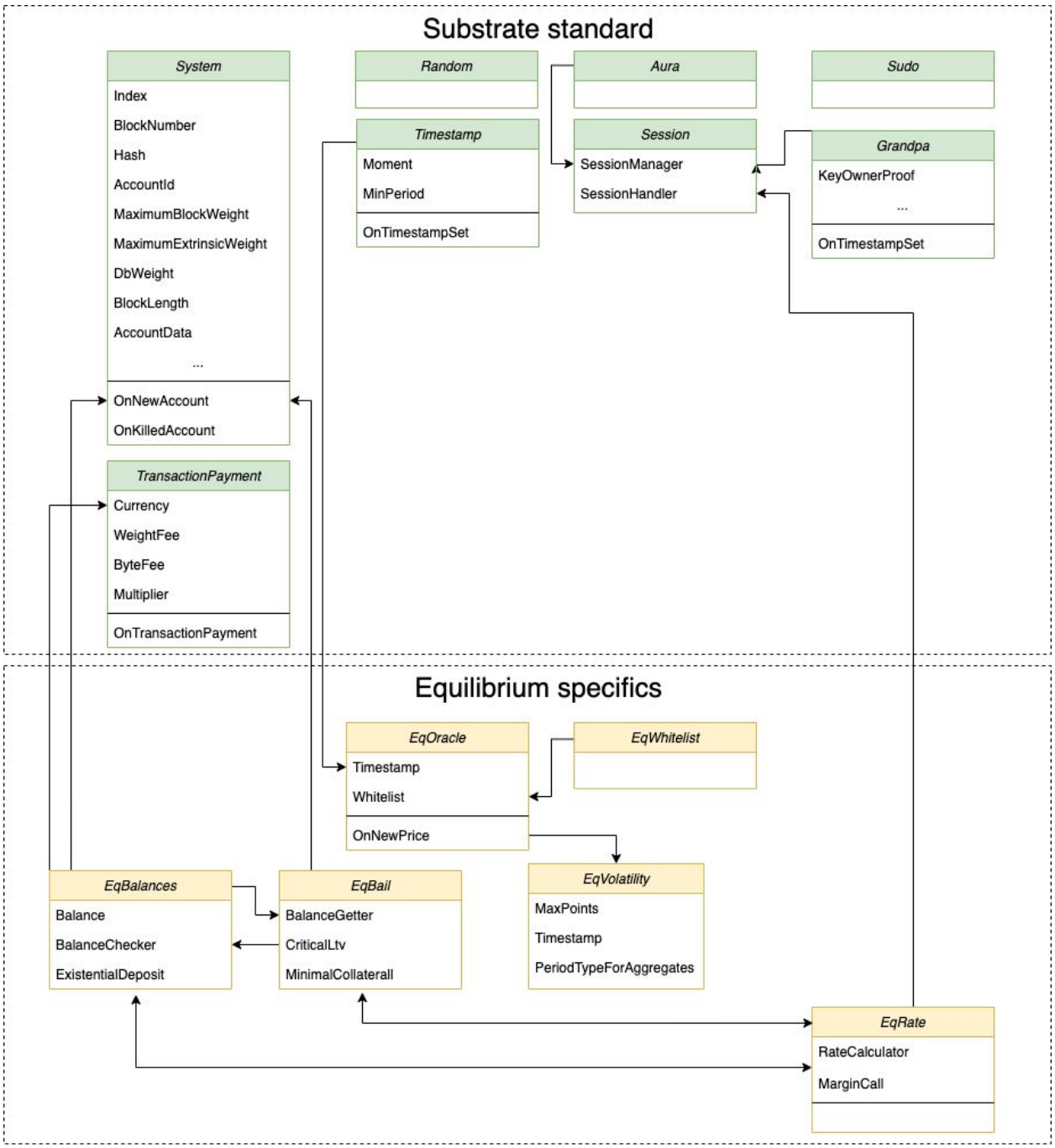
Forkless upgrades: Out-of-the-box mechanisms are provided to perform easy upgrades of blockchain logic. The substrate comes with the tools to help networks decide which upgrades to implement.

Consensus and Finality: Built-in consensus and finality mechanisms allow blockchains to come to a quick consensus and reach irreversibility or finality in a timely fashion.

Fast integration: Off-chain workers can integrate data, business logic and complex computations into the blockchain with ease.

5.1. System architecture

Equilibrium uses substrate pallets as different modules for handling system components. The following is a high level overview of what is under the hood of Equilibrium's Substrate:



Pallet	Description
System	The System module provides low-level access to core types and cross-cutting utilities. It acts as the base layer for other pallets to interact with ubstrate framework components.
Random	Simple randomizer. Used to support basic

	substrate functionality.
TimeStamp	Allows validators to set and validate timestamps on each block. Provides functionality to get and set on-chain time.
Aura	PoA consensus pallet
Grandpa	GRANDPA finality module for runtime. It manages the GRANDPA authority set for the native code. Will be used in conjunction with AURA.
Session	The Session module allows validators to manage their session keys, provides a function for changing the session length, and handles session rotation. Used to make validators perform extra work such as margin call calculations.
SUDO	Adds root users to the substrate, enables the creation of settings and to later manage them under root.
TransactionPayment	Handles trx fees and fee logic. A detailed description of fees follows below.
EqOracle	Pallet for feeding prices on-chain. Handles several data sources and feeders, and calculates the median value of an asset price.
EqVolatility	Calculates per token volatilities and asset correlation matrices at given frequencies (default time interval = 1 day)
EqWhitelist	Allows root to add/ remove users/ validators to the whitelist. Whitelisted actors are allowed to feed prices into the Substrate.
EqBalances	Implements Currency Trait. This pallet handles the balance operations logic for borrowers. Borrowing increases the negative balance of the asset on the account.
EqBail	This pallet handles the balance operations for bailsmen. It also contains the logic for system fee redistribution and liquidated collateral and debt redistribution among bailsmen.
EqRates	Handles the redistribution of user subsets

	among the validator set with the help of the Sessions pallet. Performs the following calculations: Per borrower system fees calculations. Stress testing of the system's collateral and bailout pools. Per borrower LTV ratio monitoring and liquidations (margin calls).

One important concept that runs throughout the system is the need to periodically recalculate and apply the fee that each borrower should pay. Individual borrowers trigger these recalculations each time they deposit, withdraw or transfer assets. Bailsmen keep track of accrued fees per each borrower and may trigger recalculations and fee deductions themselves when a certain threshold is reached. Finally, validators themselves trigger these calculations as well: each time a validator gets a random list of borrowers, they will be entitled to calculate fees for that. Validators do not pay transaction fees, so it is natural to make them perform heavy calculations such as calculating fees per user on a block-by-block basis.

System design also supports auto-liquidation of undercollateralized borrowers: an off-chain worker feeds the lowest N LTV ratios by account id into the run-time, and if it turns out that any of the LTV ratios breaches the liquidation threshold (100%), then the borrower's collateral and corresponding debt gets redistributed among the bailout pool stakers.

5.2. Cross-chain communications

In the event that there will not yet be any functional bridges in the Polkadot ecosystem by the time that Equilibrium launches its DeFi substrate, we will build our own solution by adhering to the roadmap described further below. The technology will also enable promptly rolling out bridges to blockchains that are not yet connected to the Polkadot network.

Ethereum and EOS are, to date, the two biggest smart contract enabled blockchains, both by market cap and number of daily user metrics. Equilibrium's cross-chain communications protocol will operate on both of these networks, and interoperability between them will be achieved via Polkadot's Substrate technology. Equilibrium will initially focus on bridging ETH and EOS into Polkadot, and will build DeFi infrastructure around pegged tokens coming from these two chains. As development and ecosystem growth progresses, Equilibrium will add other blockchains.

The table below outlines the roadmap that Equilibrium will adopt in building its cross-chain solution. The entire protocol will be an event-based setup where events will originate in the source blockchain and will be relayed to a destination blockchain depending on the particular business case.

Stage	Approx. timeline	Description
Stage 1: MVP	Q3 2020	ETH relays who stakes ETH and processes deposits/ withdrawal transactions in ETH-substrate interoperability. EOS relays who stakes EOS and processes deposits/ withdrawal transactions in EOS-substrate interoperability. Final centralized SUDO validation of relay actions in both originating and destination chains. Substrate with relay governance and reward/ punishment logic.
Stage 2: Intermediate	Q4 2020	Add contestation period and another type of validators called fishermen into the setup to remove the centralized validation step. Any willing party may stake collateral to the smart contract in the event-originating blockchain and initiate a contesting period in an attempt to contest the event when in doubt. These are so-called fishermen. If the fisherman wins the contest, he is entitled to a premium (whether the fisherman wins will be checked in a centralized SUDO manner). If he loses, he is punished by paying a fraction of his stake.
Stage 3: Decentralization	Q1 2021	Anybody willing to become a relay stakes ETH or EOS to the corresponding smart contract and feeds events with proofs to the substrate. Any relay may contest the validity of the proof of the other relay and either be rewarded or punished for this contest. At this point there is no need for validators to hold stakes on corresponding smart-contracts, collateral will be locked only for the period of transaction validation and finalization. ETH: to verify agreement in PoW blockchains, a *Proof of Proof of Work* is used, also called a simple payment verification (SPV).

		EOS: to verify agreement in PoS blockchains, a dynamic collection of the signatures that capture the current stake distribution of the block producers is provided. Verifying all block headers results in proof complexity linear to the size of the blockchain. However, there are techniques for achieving sub-linear (logarithmic to the size of the chain) complexity, which rely on probabilistic verification. We will consider ongoing work in this direction to eventually choose a secure and economically viable approach.
Stage 4: Governance	Q2 2021	New smart contract versions both in ETH, EOS and Substrate blockchains. Governance and parameter changes within the Substrate become decentralized rather than SUDO. PoS is used where validators in the substrate stake Equilibrium's Native Utility Token to govern the entire system.

5.3. Price feeds

Any willing whitelisted party and system validators can feed prices into the system via an off-chain worker designated for this purpose. The price feeding logic consists of two main functional elements:

Medianizer:

The medianizer provides Equilibrium's trusted reference price for different assets. It maintains the whitelist of price feed accounts which are allowed to post price updates and a record of recent prices supplied by each address. Every time a new price update is received, the median of all feed prices is re-computed and the medianized value is updated.

Data Processor:

In order for Equilibrium's framework to function properly and smoothly, we need to preprocess and store asset prices, as well as calculate asset stats, such as log returns, volatilities and correlations, to be further used in our risk and pricing modules. Any asset within the system will be handled as a double map <assetId, frequency> → (prices, logReturns, correlations, volatility) where frequency denotes the time interval between data points stored inside the prices and logReturns arrays (e.g. 1 minute, 1 hour, 4 hours, e.t.c), while correlations and volatility will be calculated using those arrays.

6. Summary

Equilibrium has already delivered one of the most advanced and useful DAPPs built on the EOS blockchain to date. But the potential for serving the greater crypto community by offering it a broad pool of financial products like decentralized leverage, a stable unit of account, money market protocols, and synthetic assets is still largely untapped.

Equilibrium will become the #1 DeFi app by offering exceptional services to the users of major crypto assets like BTC, ETH, XRP, BNB, EOS, XTZ, DOT, i.a.. All this will become possible thanks to Polkadot's technology and its substrate framework for creating decentralized systems. Building such a system on the substrate will in turn help Polkadot to differentiate its technology from other blockchain 3.0 projects such as Kava, Cardano, and Algorand.

The potential to re-shape the DeFi space here is immense. The times of fragmentation of users across various DeFI protocols and different blockchains is coming to an end, Equilibrium will unite them all and has developed a solution that combines the capabilities of the top 3 DeFi protocols by locked value (Maker DAO, Compound, and Synthetix).

7. References

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