

# ConcordFi

## Protocol Whitepaper

### V1.0

Address: (landing page)  
Powered by Protofire Gravity

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#### **Abstract**

ConcordFi is an algorithmic-based money market protocol designed to bring a complete decentralized finance-based lending and borrowing system onto the [IoTeX](#) Chain. ConcordFi establishes money markets with algorithmically set interest rates based on supply & demand and is designed to protect the equilibrium between borrowers and suppliers by allowing liquidators to handle volatilities and act as stabilizers. ConcordFi smart contracts are based on Compound Finance protocol. This document describes the theory and definitions behind the ConcordFi protocol, features and different aspects of the implementation.

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# Introduction

ConcordFi is a non-custodial money market platform for earning interests on lending and borrowing crypto assets. The protocol is operated by ConcordFi which is an IoTeX based organization. It is IoTeX-native, white-label implementation of Protofire Gravity in the IoTeX ecosystem. Suppliers and borrowers of a crypto asset interact directly with the protocol, earning and paying a floating interest rate. without having to negotiate terms with a peer or counterparty. Users can instantly lend any supported assets on the platform, and use the provided capital as collateral to borrow another supported asset.

ConcordFi is governed by a series of smart contracts that allow borrowing and lending crypto between users and without the need for intermediaries on IoTeX Mainnet. All terms and conditions such as collateral factor, interest rate mechanisms are embedded in the protocol and presented under the Input Factors section.

With ConcordFi protocol users can:

- Supply assets and earn interest based on the market demand
- Borrow assets and pay interest based on the market demand
- Act as liquidators by supplying to the liquidation pool with Atomica Liquidation bot

Users can receive a crypto-backed loan by utilizing their assets as collateral, while holding on to another crypto asset that may appreciate in value. It offers cryptocurrency loans to the borrower allowing them to earn interest on the collateral the whole time that it's locked. As a completely decentralized protocol ConcordFi lending returns and borrowing rates reflect underlying liquidity pools. Both borrow and supply Interest rates are algorithmically adjusted based on the demand and supply.

To protect the equilibrium between borrowers and suppliers ConcordFi uses liquidation mechanisms to handle volatilities and keep the protocol solvent. Liquidation markets act as a backstop mechanism and allow liquidators to be a buyer of the last resort to prevent near-zero collateral liquidations by bidding at healthier rates during market turmoil. Liquidators get liquidation incentive for keeping the system solvent and are able to buy the underlying collateral at a discount.

Non-custodial smart contracts allow users to make seamless on-chain & off-chain transactions of digital assets. ConcordFi protocol contains a transparent and publicly-inspectable ledger, with a record of all transactions and historical interest rates.

# Features and Specifications

## Supplying Assets

Users can supply assets by sending the tokens they intend to lend into a pool using a smart contract. When the user supplies a crypto asset to the ConcordFi Protocol, it begins earning a variable interest rate determined by the interaction of supply and demand.

Earned interest depends on the utilization of the asset pool, the more assets are utilized, the higher is the earned interest rate. Interest accrues every IoTeX block and the user can withdraw the principal of the supplied crypto asset plus interest anytime.

Once users supply assets to a smart contract, they become available to other users to borrow. Afterward, the smart contract issues gTokens that are doled out automatically to the lender.

On the other hand, smart contracts issue loans to borrowers that are collateralized by other crypto assets that are worth more than the actual loan itself. User deposits provide the pools of liquidity made available on the platform to borrowers, while also granting the ability to act as collateral. Users can use their supplied assets as collateral to borrow tokens of their choice which are supported by the protocol. By doing so users will continue earning interest on their supplied assets but also accrue interest on the borrowed assets that has to be repaid in order to release their total supplied balances.

## Borrowing Assets

Once the coins are sent to a smart contract, they become available to other users to borrow. In order to borrow crypto from ConcordFi, the user needs to supply another type of crypto as collateral. To use supplied crypto assets as a collateral the user needs to enable them to be used as collateral. Supplied crypto assets can be used to multiple markets and borrow different tokens proportionally.

Supplied collateral assets continue earning interest while in the protocol, but users can't redeem or transfer assets while there is an open borrow position which uses that collateral. The interest payable by the user is a variable interest rate algorithmically calculated based on the market's demand and supply. The interest accrued from your borrowings is added to the borrowed assets balance, therefore, the balance of borrowed assets that a user needs to repay will grow over time. Input Factors such as the current value of the supplied collateral and collateral factor will determine a borrower's limit.

## Interest Rate Model

After supplying your assets to ConcordFi protocol you begin earning a variable interest rate determined by the interaction of supply and demand. Interest rates earned and payable by the users accrue every IoTeX block. All interest rates are determined as a function of a metric known as the utilization rate. For the borrowing rate's calculation ConcordFi uses the "Jump Rate" algorithmic model. The Supply Interest Rate is dependent on the borrowing rate.

In ConcordFi the interest is accrued on every operation, which increases compounding. Annual accrued interest (APY) is calculated based on the applied Borrow/Supply Rate compounded by the number of blocks per year.

$$APY = (1 + APR / B)^B - 1$$

where,

APY - accrued interest, annual percentage yield

APR - annual percentage rates for Borrow / Supply amounts

B = the number of blocks in the year,

### Borrow Interest Rate Calculation

$$\text{Borrow APR} = \text{Base Rate} + \text{Multiplier} * \min(U, \text{Kink}) + \text{JumpM} * \max(0, U - \text{Kink})$$

### Supply Interest Rate Calculation

$$\text{Supply APR} = \text{Borrowing Interest Rate} * U * (1 - \text{Reserve Factor})$$

#### **where:**

*Base rate per year:* the minimum interest rate used in the interest rate model.

*Multiplier per year:* the rate of increase in interest rate with respect to utilization (U).

*Jump Multiplier per year: (JumpM)* the rate of increase in interest rate with respect to utilization U after the "Kink"

*Kink:* the point of utilization after which the interest rate model follows the jump multiplier.

*Utilization:* The percentage of borrowed amount out of the total supplied amount deducted the reserves.

## Liquidity Risk

The protocol does not guarantee liquidity; instead, it relies on the interest rate model to incentivize it. In periods of extreme demand for an asset, the liquidity of the protocol (the tokens available to withdraw or borrow) will decline; when this occurs, interest rates rise, incentivizing supply, and disincentivizing borrowing. If a large amount of capital moves in or out of the system, it will result in high volatility of interest rates.

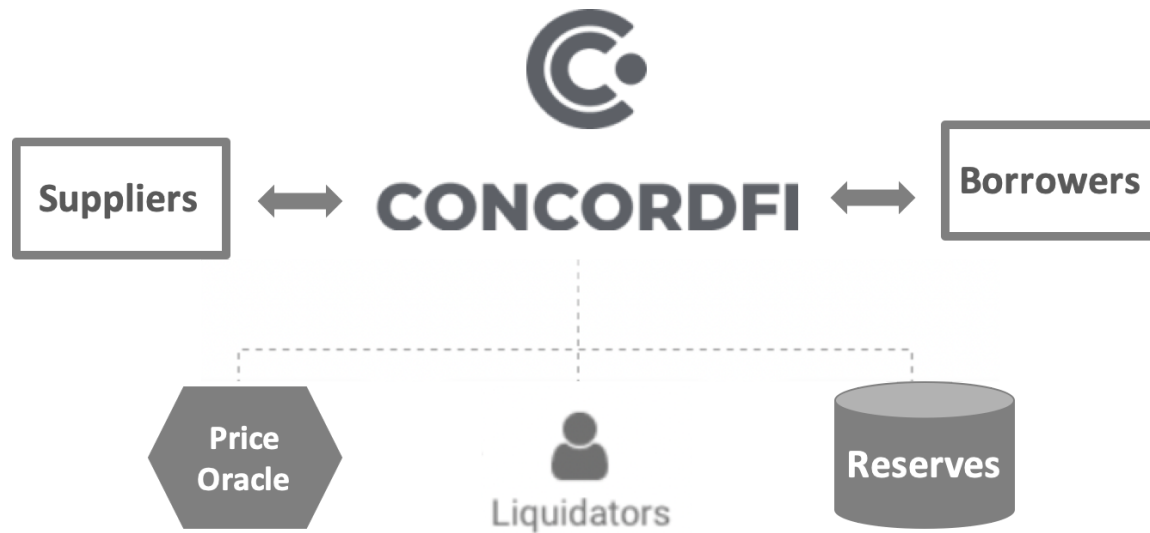
To mitigate liquidity risks ConcordFi uses [Atomica's](#) Liquidation bot and implements liquidation incentive (bonus) for the liquidators.

## Liquidation Incentive Structure

Liquidation Markets act as a backstop mechanism and allow users to repay the debts of the borrowers and receive a liquidation incentive (bonus) for doing so and keep the system solvent.

Liquidation event happens when the collateral value decreases under a specific threshold, which is defined by Collateral Factor (CF). When the collateral value drops, the borrow limit percentage will increase to a less safe level. When the collateral amount decreases, the health factor should be calculated to see if the liquidation event happens. Health factor is a value between 0 and 1 and is calculated by multiplying the total amount of all supplied assets by the collateral factor and dividing by the total amount of all borrowed assets. If the health factor is less than one the associated debt can be made available for liquidation by the smart contract and the collateral will be liquidated. Debt can be rescued by “topping up” the collateral to increase the safety of the loan and avoid liquidation.

# Implementation and Architecture



ConcordFi is governed by a series of smart contracts that allow borrowing and lending crypto between users. The ConcordFi protocol does not support specific tokens by default, instead, markets must be whitelisted.

This is accomplished with an admin function,  
*supportMarket(address market, address interest rate model)*  
that allows users to begin interacting with the asset.

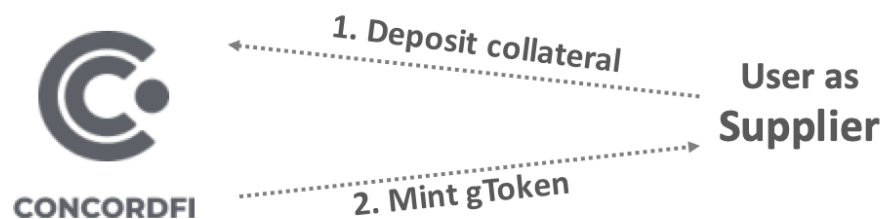
In order to borrow an asset, there must be a valid price from the Price Oracle.  
in order to use an asset as collateral, there must be a valid price and a collateralFactor.  
Each function call is validated through a policy layer, referred to as the Comptroller,  
which validates collateral and liquidity, before allowing a user action to proceed.

## gToken Contracts

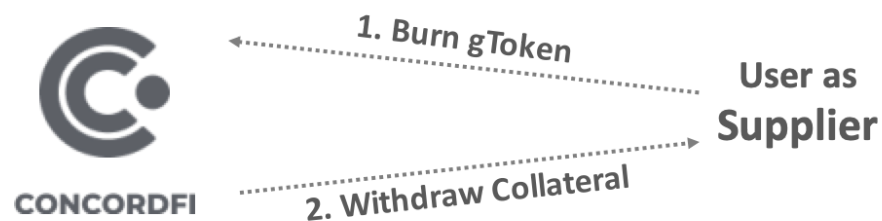
Each money market is structured as a smart contract that implements the ERC-20 compatible token specification. gTokens are the interest bearing, tokenized representations of the supplied assets issued according to the ERC20 standard. The gTokens give a representation of the proportionate value of the original crypto asset on the protocol and users' balances are represented as gToken balances.

Minting and burning of gToken on the ConcordFi protocol are completed through the smart contracts. Burning the gTokens signifies a complete redeeming for the original crypto asset.

When users supply assets to the ConcordFi protocol gTokens will be minted by calling *mint (uint amountUnderlying)* function,



Users can redeem gTokens for the underlying asset by calling *redeem (uint amount)* function.

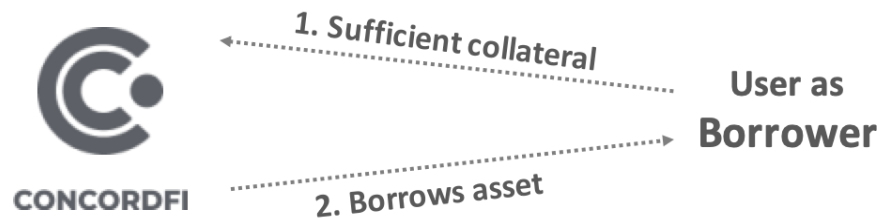


The price (exchange rate) between gTokens and the underlying asset increases over time, as interest is accrued by borrowers of the asset, and is equal to:



$exchangeRate = (underlyingBalance + totalBorrowBalance - reserves) / gTokenSupply$  .

A user who wishes to borrow and who has sufficient balances stored in ConcordFi may call *borrow (uint amount)* function on the relevant gToken contract.



This function call checks the user's account value, and given sufficient collateral, will update the user's borrow balance, transfer the tokens to the user's address, and update the money market's floating interest rate.

The borrower has the right to repay an outstanding loan at any time, by calling *repayBorrow(uint amount)* which repays the outstanding balance.



During every Borrowing and collateral withdrawal transaction users can apply SafeMax function, which tells the max amount that can be borrowed in order not to get liquidated.

## Interest Rate Mechanics

ConcordFi money markets are defined by an interest rate, applied to all borrowers uniformly, which adjust over time as the relationship between supply and demand changes.

The history of each interest rate, for each money market, is captured by an Interest Rate Index , which is calculated each time an interest rate changes, resulting from a user minting, redeeming, borrowing, repaying or liquidating the asset.

Each time a transaction occurs, the Interest Rate Index for the asset is updated to compound the interest since the prior index, using the interest for the period, denominated by  $(r * t)$ , calculated using a per-block interest rate:

$$Index\ n = Index(n-1) * (1 + r * t)$$

The market's total borrowing outstanding is updated to include interest accrued since the last index:

$$totalBorrowBalance_n = totalBorrowBalance(n-1) * (1 + r * t)$$

And a portion of the accrued interest is retained (set aside) as reserves, determined by a reserveFactor, ranging from 0 to 1:

$$reserves = reserves(n-1) + totalBorrowBalance * (r * t * reserve\ Factor)$$

A borrower's balance, including accrued interest, is simply the ratio of the current index divided by the index when the user's balance was last checkpointed.

The balance for each borrower address in the gToken is stored as an account checkpoint. An account checkpoint is a Solidity tuple. This tuple describes the balance at the time interest was last applied to that account.

## Liquidation

To attract liquidators and make liquidations available ConcordFi protocol uses a liquidation bot made by Atomica DAO. Atomica Liquidation Markets are non-custodial liquidity pools that programmatically participate in collateral liquidations of the DeFi lending protocols.

The liquidation bot monitors pending transactions and looks for borrowings that are eligible for the liquidation. If a user's borrowing balance exceeds the borrowing capacity due to the value of collateral falling, or borrowed assets increasing in value, the public function can be called:

$$liquidate(address\ target, address\ collateralAsset, address\ borrowAsset, uint\ closeAmount)$$

which exchanges the invoking user's asset for the borrower's collateral at a discount determined by the Liquidation Incentive Factor.

The maximum amount that users can liquidate in one transaction is bounded by the Close Factor, ranging from 0 to 1. If a user has multiple borrowed assets, the Close Factor applies to any single borrowed asset, not the aggregated value of a user's outstanding borrowing.

## Price Feeds

A Price Oracle maintains the current exchange rate of each supported asset.

ConcordFi protocol delegates the ability to set the value of assets to the Chainlink Price Oracle through IoTube. IoTube is used to connect Chainlink price feeds on Ethereum to the IoTeX network. It instantly relays Chainlink prices to a permissionless contract called as shadow aggregator on IoTeX, which has exactly the same interface as Chainlink's aggregator and allows effortless and quick update of market prices. The wait time to confirm the transaction is 20 blocks (around 5 minutes).

Updated prices from the Chainlink Price Oracle are the current volume-weighted average of the aggregated prices retrieved from centralized and decentralized exchanges, which are continually updated in order to closely follow volatility. Price and volume can vary across different exchanges and data providers, especially at times of increased volatility. Redundancies and volume weighting play an important role here.

Chainlink Price Oracle formats the data into a blockchain-readable format, signs it to prove its provenance, aggregates it across multiple sources, and stores the current volume-weighted average price (VWAP) of cryptocurrencies in on-chain reference contracts. The provided data is collected from numerous premium data aggregators, leading to price data that's aggregated from hundreds of exchanges, weighted by volume, and cleaned from outliers and wash trading.

To enhance additional security ConcordFi implements Alpha Homora simple price oracle contract and protects the users and the protocol from incurring losses in case of spot price manipulations and attacks.

## Input Factors

The following input parameters are implemented in smart contracts and calculations.

Input Factors	IOTX	USDT	Description
Reserve Factor	10%	7%	The rate for a given asset that is routed to that asset's Reserve Pool
Collateral Factor	60%	80%	Loan to value ratio (LTV): The size of the amount that can be borrowed relative to its collateral value.
Close Factor	50%	50%	The proportion eligible to be liquidated by any individual liquidator at once.
Liquidation Incentive	1.05	1.05	The additional collateral given to liquidators as an incentive to perform liquidation of underwater accounts.
Base Rate	2%	0%	The minimum interest rate used in the interest rate model.
Multiplier	15%	5%	The rate of increase in interest rate with respect to utilization (U).
Jump Multiplier	109%	109%	JMult: The rate of increase in interest rate with respect to U after the "Kink"
Kink	80%	80%	The point of utilization after which the interest rate model follows the JMult
Price Oracle update time	5 min	5 min	The time that is needed to update spot prices from price oracles.
Time per block	7.5 sec	7.5 sec	The average time that the IoTEx blockchain finalizes a block.
Blocks per year	4204800	4204800	Seconds per year divided by Time per block
Days per year	365	365	Number of days per year

# Summary

ConcordFi protocol creates a money market platform for IoTeX Mainnet. It is IoTeX-native, white-label implementation of Protofire Gravity in the IoTeX ecosystem.

Users can supply tokens to a money market to earn interest, without any intermediaries. Users can borrow a token by using their balances in the protocol as collateral. All assets in the protocol are represented by gTokens. Each money market has interest rates that are determined by the supply and demand of the underlying asset. When demand to borrow an asset grows, or when supply is removed, interest rates increase, incentivizing additional liquidity. Liquidators can supply to the liquidity pool, get the liquidation incentive and help keep the protocol solvent during the high fluctuations of underlying asset prices.

## References

(To be edited contract addresses...)

[Comptroller Contract](#)

[gIOTX Contract](#)

[CRX20DELEGATE](#)

[CXRC20DELEGATOR](#)

[UNDELYING ASSET Contract](#)

[JumpRateModeV2\\_IOTX&USDT](#)

[Unitroller](#)

[Maximillion](#)

[Alpha Homora SimpleOracle](#)

[Chainlink Price Oracle](#)

[Atomica Liquidation Markets](#)

[Compound Finance Protocol](#)

[C.R.E.A.M Finance Protocol](#)

[C.R.E.A.M Finance Contracts](#)