A Unique Prediction Market Powered by Predix Network

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Abstract

PreDex is a prediction market powered by Predix Network and its native PRDX that allows for transparent and non-custodial leveraged predicting on Uniswap pairs. By its specific way of handling leverage and risk users can make leveraged predictions while only risking a default percentage of the prediction value. Instead of supporting a few preset timescales as seen with many prediction markets, PreDex supports customizable time intervals using theta decay. With liquidity incentives PreDex allows for users to get rewarded for showing proof of liquidity while simultaneously strengthening the underlying Uniswap pair against price manipulation.

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Introduction

PreDex is powered by Predix Network and is a diverse prediction protocol supporting all Uniswap pairs available with built-in liquidity incentives. PreDex aims to facilitate an interesting trading and liquidity product for users in a trustless, transparent and non-custodial way. With the use of reward curves, invalidation curves and theta decay the prediction market allows for leveraged predictions on any Uniswap for any timestamp[1] in the future while risking a default percentage of the total prediction value.
Users select one of the many listed pairs and provide a timestamp and a price prediction together with any amount of PRDX they would like to add. During the prediction time, the tokens are held in the contract. After the prediction time has ended, users get the option to claim their profits or wait in the hope their prediction becomes more accurate.
In the section "Uniswap integration" the specific mechanisms to support all Uniswap pairs will be discussed, as well as how prices are calculated and price manipulation prevented. In the "Reward mechanism" section the math determining the profits/losses for a specific prediction is explained, including an example of how the whole system would work from the moment of making a prediction to claiming the reward. The "Liquidity incentive" section touches on a low-risk method of earning rewards with PreDex using the Uniswap-native liquidity tokens. The section "Strategies" aims to show some of the possibilities and give the reader ideas of how one could use PreDex. In the last section, "Future development", a vision of a fully decentralized prediction market where users can make their own customizable prediction markets for any pair is elucidated.

Uniswap integration

Uniswap is a versatile protocol on Ethereum supporting all possible ERC20 trading pairs using a formalized model for pooling liquidity reserves. Because of its strong codebase with many useful interfaces, other smart contracts get access to many different functions like token reserves, price oracles and much more. In the "Available pairs" section the listing mechanism of pairs will be explained. How PreDex determines the safely price of the pair at the moment of settlement is explained in the "Price fetching" section.

Available pairs

As stated earlier, PreDex supports all possible Uniswap pairs. However, not all pairs will be eligible for a listing because of low liquidity or low volume. As low liquidity pairs are easy to manipulate, users could move the price wherever they want as to make their prediction become accurate and thus earn big rewards.
To prevent the forementioned problem, only high liquidity and volume pairs will be listed initially. As the cost to manipulate the price grows linearly[2] with the liquidity reserves it is for very liquid pairs typically not profitable to do so.
By the process of voting and community sentiment new pairs will be listed by the team. In the future, this point of centralization will be completely removed and users will be able to create their own prediction markets. This vision is further explained in the "Future development" section.

[1] Note that there is a minimum prediction age and maximum prediction age, this is further explained in the reward mechanism section.

[2] See `https://uniswap.org/docs/v2/core-concepts/oracles/`

Price fetching

Uniswap supports interfaces which make possible to retrieve the liquidity reserves for the two tokens of the pair programmatically. As described in the Uniswap whitepaper, it is then trivial to calculate the price of the pair consisting of asset A and asset B:

$$r_t = \frac{r_t^A}{r_t^B} \tag{1}$$

However, with the introduction of flash-swaps in Uniswap v2 it is not safe anymore to rely on this method. Using the Uniswap v2 native flash swaps one can change the liquidity reserve ratio and thus influence the settlement price for negligible cost.
To prevent this, PreDex uses a time weighted average price (TWAP). The Uniswap v2 core contracts store a cumulative price allowing other contracts to calculate a TWAP. To settle a prediction, the user has to make two calls n minutes apart. The first call stores the cumulative price at that instant. The second call again gets the cumulative price and then calculates the TWAP[3] and settles the prediction. This means that essentially a user predicts on a future TWAP instead of a SPOT price.
By using the TWAP as described above, the costs of manipulating this process grow as the liquidity and trading volume of the pair increases. For highly arbitraged pairs like ETH/USDT or wBTC/ETH any attempt to control the price during the period over which the TWAP is calculated is naturally prevented. This means that for such pairs n can be lower while still providing enough security. For pairs with a lower degree of arbitrage activity or lower trading volume, n has to be higher to provide the user with enough security.

Reward mechanism

The PreDex contract holds a total of 300,000 PRDX for users to be won. The calculation of the reward for a specific prediction depends on multiple variables: the prediction value (the amount of PRDX added to the prediction), the predicted price, the close price (price at moment of settlement), the prediction age, the time of closing the prediction and the leverage. This is summarized in the following equation:

$$P(N, p_{pred}, p_{close}, T, t_{close}, \lambda) = \begin{cases} N \cdot f(p_{pred}, p_{close}) \cdot Y(T) \cdot \theta(T, t_{close}) \cdot \lambda & x \leq \eta(T) \\ (r-1) \cdot N & x > \eta(T) \end{cases} \tag{2}$$

where P is the net profit (negative meaning a loss), N the prediction value in PRDX, p_{pred} the predicted price, p_{close} the price at the moment of settlement, T the prediction age, t_{close} the time of settlement, λ the leverage, $f(p_{pred}, p_{close})$ the reward curve, $Y(T)$ the time reward factor, $\theta(T, t)$ the theta decay factor, $\eta(T)$ the invalidation curve, $x = x(p_{pred}, p_{close})$ the percentage difference between the predicted price and the close price and $0 \leq r \leq 1$ the refund percentage. The functions $\theta(T, t)$, $f(p_{pred}, p_{close})$, $Y(T)$ and $\eta(T)$ will be explained in detail in the sections hereafter.

[3] See `https://uniswap.org/docs/v2/core-concepts/oracles/`

Reward curve

The reward curve is an ever-decreasing function describing the accuracy of the prediction based on the percentage difference between p_{pred} and p_{close}. The reward curve is characterized with the following equation:

$$f(x) = 1 + \frac{1}{100}\left(x - 20\sqrt{x}\right) \tag{3}$$

where x is the absolute percentage difference between p_{pred} and p_{close}, as described by the equation:

$$x(p_{pred}, p_{close}) = \frac{|p_{pred} - p_{close}|}{p_{pred}}. \tag{4}$$

A plot of equation (3) for percentages from 0 to 100 can be seen in figure 1.

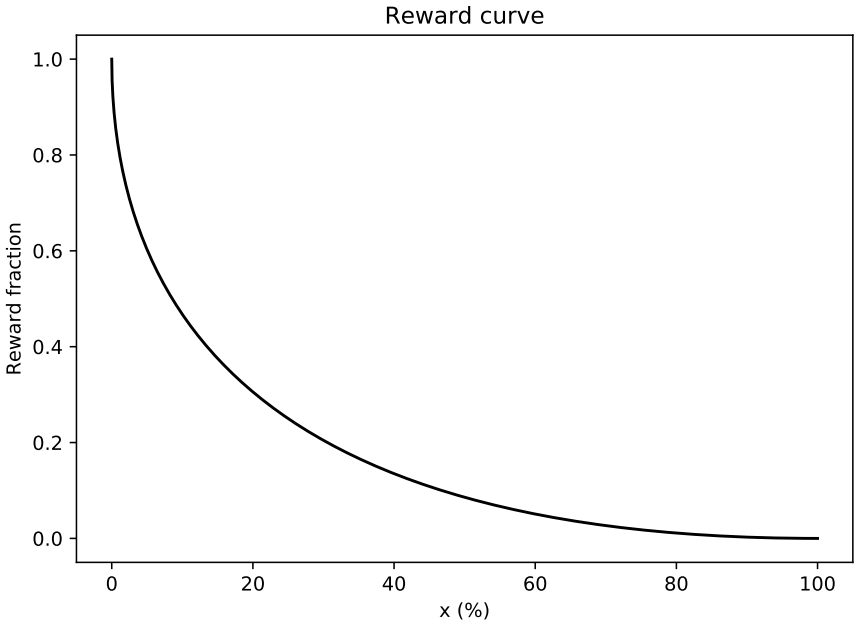

Figure 1: The reward curve as described by (3). The horizontal axis represents the percentage difference between p_{pred} and p_{close}. The vertical axis is the reward fraction, which is simply a factor that is used to multiply with as to calculate the profit of the prediction on settlement.

As can be seen in figure 1, the reward curve outputs a number between 0 and 1. This value can easily be scaled with a simply multiplication factor as to find the optimal balance between risk/reward for the specific underlying trading pair.

Invalidation curve

To determine whether a prediction is considered "right" or "wrong" the invalidation curve is used. The invalidation curve is a formula that tells you how much the predicted price can be off from the actual close price at settlement before being considered "wrong". The invalidation curve is formulated using a logarithmic equation:

$$\eta(T) = \log_2(T) + \frac{78}{t_{year}} \cdot T - 8 \tag{5}$$

where T the prediction age and t_{year} the duration of 1 year in seconds[4]. The specific constants (78 and -8) are chosen as to make the invalidation percentages at the minimal prediction age of 1 hour and maximal prediction age of 1 year reasonable. For a prediction age of $T = 3600s$ the invalidation percentage is approximately 3.8%. The invalidation percentage for the maximum prediction age of $T = t_{year} = 31540000s$ is approximately 95%[5].
The forementioned restrictions on the prediction age are set in place as to prevent price manipulation at short time intervals and risk-free predictions for the downside when the invalidation percentage grows larger than 100%[6]. The curve is plotted in figure 2.

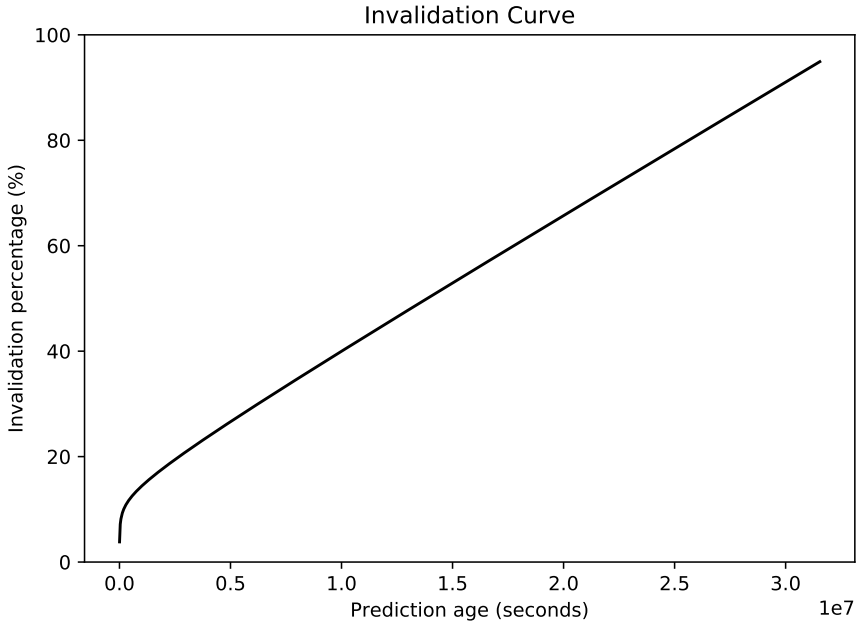

Figure 2: The invalidation curve as described by (5). The horizontal axis represents the prediction age in seconds. The vertical axis is the invalidation percentage in percentages, telling you how much "you can be off" before being considered a wrong prediction. Naturally, the longer you predict the price in the future, the bigger the invalidation percentage.

[4]The invalidation percentage used for the reward calculation is divided by the leverage. For more information on this, please refer to the "Leverage" section.

[5]Note that these numbers can change for different pairs as the underlying assets naturally behave differently. This is however, off course, fully transparent and verifyable using the open-source contracts as these calculations are done on-chain.

[6]The maximum the price of an asset can go down naturally is 100%. So if one makes a prediction for e.g. 2 years, causing $\eta(T)$ to grow over 100%, one cannot lose as long as the price stays under the predicted price.

Now, figure 2 tells you that for a prediction age of 1 year you can be off by approximately 95% and still be considered a correct prediction. However, one must realize that during the prediction one suffers from opportunity cost. Besides, the reward curve largely mitigates this effect by returning a small value for predictions that are off by far. Strategies involving these trade-offs are touched on in the "Strategies" section.

Theta decay

Very much like options, predictions will suffer from theta decay. When a user makes a prediction at timestamp t_1 with a prediction age of T, the prediction can be closed any time after $t = t_1 + T$. This means that when a prediction seems to go the wrong way and a user is in a net loss, the user can decide to not close the prediction immediately after when it becomes available. Instead, a user can wait for price to come back to the predicted price in the hope to turn the loss back into a profit.
However, this is not at a zero cost. During the period in which a user decides to wait to claim their rewards/losses, theta decay starts to kick in. The theta decay factor $\theta(T, t)$ is described by the following equation:

$$\theta(T,t) = \begin{cases} 1 & t \leq t_1 + T + t_{free} \\ 1 - \frac{t-(T+t_{free})}{T} & t_1 + T + t_{free} < t \leq t_1 + 2T + t_{free} \\ 0 & t > t_1 + 2T + t_{free} \end{cases} \tag{6}$$

where T is the prediction age, t the time of settlement and t_{free} the decay-free period. The decay-free period is given by:

$$t_{free}(T) = \frac{T}{a} \tag{7}$$

where $a = 7$ is the decay-free fraction. This means that when $T = 1$ week, we have approximately $t_{free} = 1$ day which means there is a 1 day decay-free period in which a user can decide to settle the prediction or not with zero costs. After this period, linear theta-decay starts which drops to zero exactly T time after the decay-free period has ended. This equation is visualized in the plot in figure 3.

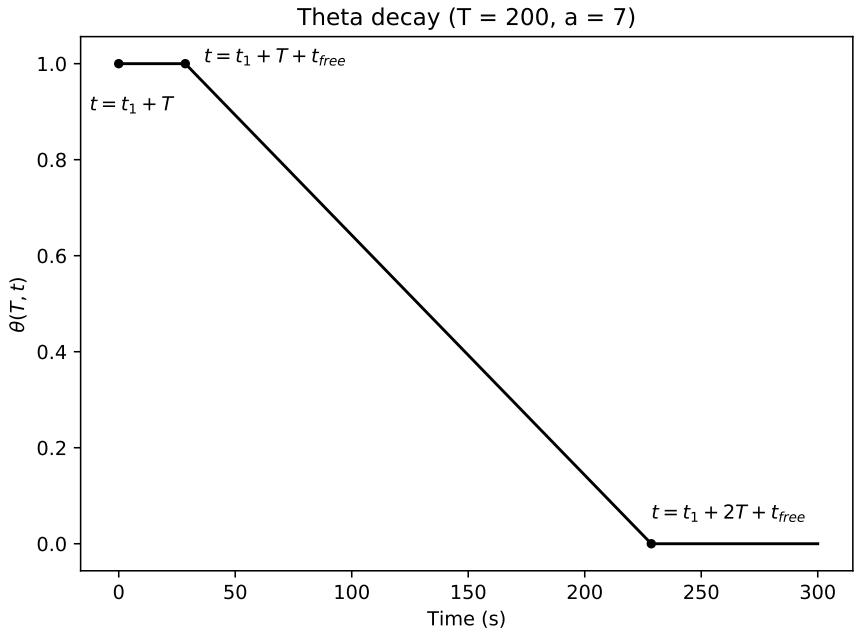

Figure 3: The theta decay curve as described by (6) for $T = 200$ and $a = 7$. The horizontal axis represents the time in seconds. The vertical axis is the theta decay factor.

Leverage

PreDex supports leverage for all pairs. The leverage λ will be multiplied with the reward you get from a "normal" 1x leverage prediction. However, leverage also increases the risk you're taking. The invalidation percentage will be divided by the leverage used for that prediction. This is described by:

$$\eta_{lev}(T) = \frac{1}{\lambda} \cdot \eta(T) \tag{8}$$

This means that when you're using leverage, your prediction will be considered wrong way faster compared to normal predictions. This means that you're taking on more risk as you increase the leverage, as expected. Using this mechanism, there is no theoretical maximum on the leverage. However, at a certain point this obviously becomes impractical to work with. PreDex does not liquidate predictions and at all times only a default percentage (described by the refund percentage) is of the prediction value is at risk.

Risk

Every prediction has a default risk as defined by the refund percentage r. This means that if you lose, you get a part of the prediction value back. The other part gets partially burnt and partially rewarded to liquidity token stakers, which is further explained in the "Liquidity incentive" section. This implies that although using leverage, you only risk $(1 - r)$ of the prediction value when your prediction is considered to be wrong. This refund percentage may be subject to change depending on prediction performance or in the case of special events. The UI will show the refund percentage and changes will be announced in due time for users to anticipate on these changes.

Example

In this section, a numbered example will be discussed from the moment of the user initiating the prediction to claiming their rewards.
Bob has some PRDX tokens and a crystal ball telling him that in two days wBTC/ETH will be at 0.05. Bob then decides to make a 2x leveraged prediction at $t = t_1$ with a value of 500 PRDX on the wBTC/ETH prediction market for 0.05 in two days. We then have $N = 500$, $\lambda = 2$ $p_{pred} = 0.05$ and $T = 2$ days. His 500 PRDX will be locked in the prediction market until $t = t_1 + T$, after which Bob is free to settle the prediction at any time. As the prediction age is 2 days, we get $t_{free} = \frac{1}{7} \cdot 2$ days $\approx 6h\ 51m$. This means that when Bobs prediction is finished, he has approximately 6 hours and 51 minutes of decay-free time to settle the prediction and claim his rewards. During this time he can decide whether to do so or not. Let's say price rises from 0.03 slowly towards his predicted target of 0.05 during the two days but then just before he is able to claim his rewards price drops to 0.04. Bob's prediction is then off by 20% while the standard invalidation percentage for a 2 day prediction age is approximately 9.8% (and thus with 2x leverage approximately 4.9%). This means that if Bob were to settle the prediction he would lose the prediction. Bob thinks the price will quickly recover so he decides to hold on to his prediction and wait. After 3 hours, price does indeed spike back up to 0.049. This is only a 2% deviation from his prediction so Bob decides to settle his prediction and claim his profit. He then makes the first call to initiate the TWAP and n minutes later finalizes the settlement and receives the rewards. As the moment of settlement is only 3 hours and n after settlement has become available, theta decay has not set in. The net profit Bob then realizes is: $500 \cdot f(0.05, 0.049) \cdot Y(2 \text{ days}) \cdot \theta(2 \text{ days}, 2 \text{ days } 3\text{h}) \cdot 2 \approx 500 \cdot 0.74 \cdot 2.7 \cdot 1 \cdot 2 \approx 2017$.[7] This means that Bob has made a profit of 2017 PRDX. Note that if Bob were to wait for a longer period, time-decay would've lowered his profit assuming the prediction is settled at the same price.

Liquidity incentive

Besides actively participating in predicting on PreDex itself, there is another low-risk way to get rewards with PreDex; proof of liquidity. Proof of liquidity (POL) is a mechanism where a user proves they are providing liquidity to a pair that is listed on PreDex by staking that specific liquidity token in the PreDex pool. This pool receives all fees and a part from the losses made on the PreDex pair. The rewards will then be distributed pro rata to all users who are "farming" using their liquidity tokens.
This system is beneficial in two ways: users get to mitigate risk by providing liquidity to a pair causing them to partially win back their losses depending on their share of the pool and prediction fees. But by providing liquidity to the pair, it becomes harder to manipulate the price and thus the PreDex pair becomes more secure and fair. A diagram to visualize this system can be seen in figure 4.

[7] For the sake of simplicity it is assumed that the TWAP has a value of 0.049 too. In reality, this could change somewhat depending on price action in the TWAP window.

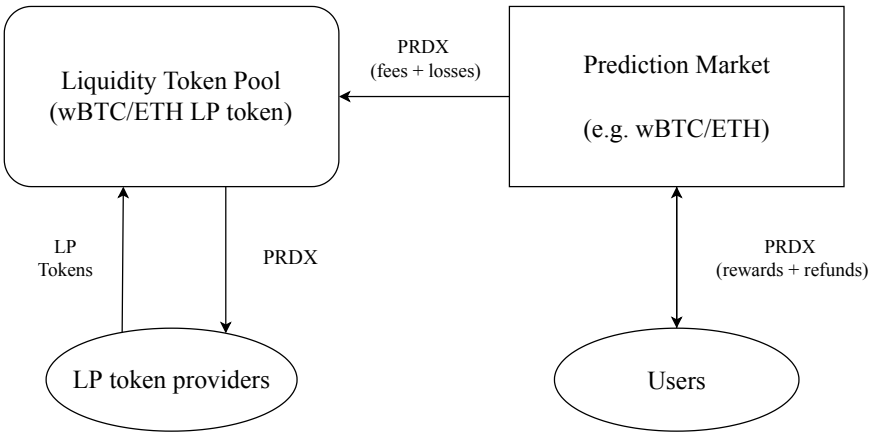

Figure 4: A diagram of the liquidity incentive system. The system rewards LP token providers for providing increased liquidity to a trading pair. This also allows for prediction market participants to mitigate risk by providing liquidity to the pair they are using.

Strategies

Because of the many different components making up PreDex, there are a lot of different strategies one might want to use PreDex for. In the subsections hereafter some of these strategies are outlined.

Hedging

One of the most obvious strategies would be to use the prediction market as an options-like tool to hedge against spot exposure on specific pairs. Because the system allows for any eligible[8] Uniswap pair many different pairs or combinations of pairs can be used to hedge. Example: if one desires to hedge against a pair of token A and token C but there are no liquid A/C Uniswap pairs available, one can do so using a bridge token B that does have liquid pairs to both A and C. This way, a user can for example make a prediction for BTC/USD by having exposure to wBTC/ETH and ETH/USD simultaneously.

Long-term bullish predictions

Many cryptocurrency users have a bullish vision on either Bitcoin or the whole cryptocurrency space as a whole. This belief can be substantiated by placing a long-term prediction on a pair with a relatively high prediction price. As the downside is naturally limited by 100% and the invalidation percentage of a 1 year prediction is 95%, one can make a relatively low-risk long-term bullish prediction. This is best explained by an example: Alice is bullish on Bitcoin[9] and wants to put money where her mouth is. Alice thinks Bitcoin will be at $50k next year but is concerned about potential short-term downside and is not too sure about this target (might be lower, might be higher). So Alice decides to make a prediction stating that Bitcoin will be at $50k a year later. At the moment of the prediction, Bitcoin is at $10k. Exactly 1 year later, Bitcoin is at $11k. Her bet is now off by approximately 78%. However, because of the high prediction age,

[8] Enough liquidity and volume.
[9] Aren't we all?

the prediction is not invalidated and thus she will still receive a reward on her prediction which could outweigh a 10% Bitcoin spot exposure. Even stronger, if Bitcoin were to drop to $9k, spot exposure would result in a net loss of 10% whereas a long-term bullish prediction would give the user a net-profit. However, one must note that for long-term predictions one does suffer from opportunity costs as the tokens are locked during the whole prediction.

Proof of liquidity

Another way to gain rewards using the prediction market system is to provide liquidity to a certain pair and showing proof of liquidity by placing the liquidity pool tokens in the prediction market pool. This pool receives rewards from all fees and losses made on the PreDex pair, which get distributed pro rata to all users participating in that pool. This also decreases the risk for the user for that specific prediction market as losses will be partially refunded through the pool. Besides, this allows for users to gain double rewards for providing liquidity for a pair: providing liquidity on a pair pays the user from the trading fees on Uniswap while putting those liquidity pool tokens in a PreDex pool then gives the user fees and losses made on PreDex for that pair.

Future development

Although already providing a lot of different ways to interact with PreDex, Predix Network is aiming to build a more generalized and decentralized perdiction market protocol in the future. This protocol will allow the user to start a decentralized and customizable prediction market for any Uniswap pair they want by providing liquidity to the prediction market.

User generated custom prediction markets

In the current system, Predix Network will facilitate the listing of new prediction market pairs. However, the PreDex contract holding the PRDX paid out as rewards will slowly run out and eventually stop. To continue the prediction markets, a more decentralized way of prediction market pair listings will be transitioned to as the reward pool slowly runs out. In this protocol, the users themselves will be able to make a customizable prediction market and provide rewards for users to win. The prediction market maker will receive the fees and losses made on the prediction market. Prediction market makers will thus customize the parameters of the market as to make it attractive for users to make predictions but will ultimately be profitable for the prediction market maker himself. However, this works both ways; users won't use prediction markets that have a bad risk/reward ratio. Naturally, an equilibrium will arise where both parties have fair chances.
This also allows for new projects to list their token on the prediction market by simply providing liquidity to their prediction market.

Custom tokens

Although it is possible to make a prediction directly with ether[10], Predix Network is aiming on building an even more general system where users can set their own deposit and reward token for that specific market. This would allow users to create prediction markets where the deposit token (the token with which they pay to make the prediction) will be different from the reward token.

[10]PRDX is bought on Uniswap with the ether provided.

DEX integration

With the rapid rise of new technologies in the DeFi-space, it is important to provide users with the most popular decentralized exchanges. Predix Network aims to implement multiple DEX support in the near-future as to not limit users to Uniswap. The focus will be on larger exchanges like SushiSwap, MooniSwap and Balancer as well as DEX's on other blockchains like Serum.

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