Bodhi: Decentralized Predictive Market at Scale

White Paper

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Draft for open community review and subject to change.

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Abstract

In this paper, we introduce Bodhi, the next generation blockchain based platform that decentralizes the prediction market. Bodhi leverages the advantages of the state-of-the-art decentralized prediction markets by integrating third-party Oracles and voting based decentralized Oracles via its Oracle abstraction layer. We intend to develop a novel replaceable Oracle framework where the prediction market is more effective and autonomous. Bodhi will be deployed on Qtum at the initial launch.

Keywords

Bodhi, Prediction Market, Smart Contract, Qtum, Ethereum

I. INTRODUCTION

Humanity has developed strong interests towards understanding history and predicting the future. What will the weather be like tomorrow? Which soccer team will win the UEFA European Championship later this year? Is Apple stock going below 100 USD per share on the first weekday of next year? People attempt to predict the results of simple yet non-trivial questions. The desire to predict what happens next has generated conventional prediction markets which are heavily regulated, such as lottery systems and stock markets, as well as illegally operated underground casinos and insider trading. Excessive regulation and legislation, implemented at large monetary costs, greatly limit the prediction market from performing its market functions. Meanwhile, conventional prediction markets have been heavily depending on centralized Oracles who set all prediction results and their fairness and charge a large amount of money. The high cost of these Oracles has significantly lowered the users' willingness to participate and prevented the prediction markets from large scale adoption.

Prediction Markets are platforms that allows individuals or a group of entities to predict the outcomes of future events, and to be incentivised from the results. Incentives will be redistributed upon the realization of outcomes of an event in which all parties participated. The fortune redistribution follows a simple yet powerful rule, that the fortune flows from less skillful and inaccurate participants to more skillful and accurate participants. In order to succeed in the prediction, participants aggressively gather information, and apply mathematical modeling to maximize the chance of prediction accurately. Statistically, the price associated with each outcome has high positive correlation with each outcome. Meanwhile, the accuracy of the prediction is largely determined by the number of participants. Starting from the very beginning of information revolution, people has been devoted to making online prediction markets to minimize the onboarding barrier for participating in prediction. However, centralized online products have yet to earn people's trust while excessive regulation and legal restrictions also greatly limits the development of the prediction market.

With the deluge of the continuous development of blockchain technologies, there is an increasing trust within communities on enabling public blockchain as Oracle that is fair and decentralized. Blockchain technology is a perfect candidate to form the building block of prediction market due to its characteristics such as information transparency and data immutability. The fairness of blockchain makes the prediction market run at low-to-no administrative cost. The application of Smart Contract empowers blockchain with a programmable and dynamic decision-making capability. All of the above emerging phenomenon resulted in the creation of decentralized prediction market.

Bodhi's mission is to build a credible, autonomous, and scalable decentralized prediction market that promotes the application of prediction market at a global scale to enhance the effectiveness of decision-making process [1].

II. RELATED WORK

Augur [2] is a blockchain based decentralized prediction market. A user can create a prediction event using Ethereum's [3] smart contract, followed by other users' predicting and pricing the probability of each outcome through native tokens. When the event eventually happens, Augur REP holders report to Augur the right prediction result. The REP holders are the building blocks of Augur platform, where these holders maintain the platform and constitute the arbitration mechanism. However, as the Augur platform scales, a fully decentralized arbitration mechanism becomes less efficient. When a large group of prediction events have been created, it is increasingly challenging for REP holders to vote for all events. REP holders might also have different domain expertise and have been exposed to events at different comfort levels. The matchmaking process between an event and event-specific expertise has yet to be improved. Moreover, problems such as high time-cost and low efficiency associated with REP holders result in a longer cycle to reach a consensus at the end of a prediction event.

Similar to Augur, Gnosis [4] is another common blockchain based decentralized prediction market that utilizes Ethereum's smart contract for event creation and prediction. Unlike Augur, Gnosis leverages a default centralized Oracle for judging prediction results. The advantage of using such as centralized Oracle solution is that prediction judgment can be performed autonomously and therefore significantly increases the judgment efficiency. However, a centralized Oracle solution can cause single point of failure in the events of, eg., server failure, and data being maliciously tampered. When any of such events occurs, all predictions will be locked and the credibility of Gnosis platform will be decreased.

Bodhi is the next generation blockchain based platform that decentralizes the prediction market by overcoming the disadvantage of both Augur and Gnosis. In contrast to Augur, Bodhi uses third-party Oracle to automatically judge the prediction results to guarantee the efficiency of the decision making process. Different from Gnosis' centralized Oracle solution, Bodhi enables BOT holders to take over the voting process and make the final decision of a prediction event in the event of Oracle failure.

III. BODHI OVERVIEW

Bodhi, the next generation blockchain based prediction market, leverages the advantages of the state-of-the-art decentralized prediction markets by integrating third-party Oracles and voting based decentralized Oracles via its Oracle abstraction layer. We introduce a novel replaceable Oracle framework so that the prediction market is more effective and autonomous.

Bodhi will first be deployed on the Qtum [5]. As more users around the world are accessing the Internet from mobile devices rather than from desktop computers, mobile computing will be increasingly important to prediction markets. Qtum combines the advantages of Bitcoin and Ethereum to provide better user experience on mobile devices. Event forecast is very timesensitive matter, but smart contract can only rely on the number of blocks to estimate the time. However, Ethereum has yet to implement the Proof of Stake (PoS). As the Difficulty Bomb of Ethereum's current Proof of Work (PoW) starts to take effect, the block time is increasing exponentially, as shown in Table I, which greatly affects the estimated time of the forecast. Qtum, which is different from Ethereum, will ensure the stability of the block time by introducing PoS at the beginning its release. Bodhi will first be deployed onto Qtum to avoid existing problems with Ethereum. However, as the user base grows, we do not eliminate the possibility to roll out Bodhi onto other public blockchains.

Block Number	Time	Block Time
3000000	2017-01-16 00:38:33	14.86
3500000	2017-04-11 18:09:34	15.27
4000000	2017-08-15 18:20:24	30.01
4500000	2018-11-03 05:55:48	136.71
5000000	2025-10-02 11:47:30	835.81
5500000	2128-03-20 09:14:16	17183.83
6000000	5189-09-26 20:57:59	520901.19

 Table I

 The effectiveness of Difficulty Bomb Affects Block Time

Bodhi uses third-party Oracle to automatically judge prediction results to guarantee the efficiency of the decision-making process. BOT holders can take over the voting process and make the final decision for a prediction event if Oracle fails. Algorithm 1 shows how Bodhi works.

As you can see, Bodhi's Oracle is replaceable. If consensus cannot be obtained through arbitration, users can continue to make deposits to request the next iteration of arbitration. As the number of rounds increases, more token deposits get accumulated and BOT holders are more motivated to maintain the accuracy of the Bodhi platform to protect their token value. Theoretically, arbitration result will converge to an accurate state. Bodhi leverages the advantages of the state- of-the-art decentralized prediction markets by integrating third-party Oracles and a voting based decentralized Oracle via an Oracle abstraction layer. This method combines the advantages of existing decentralized prediction market.

Algorithm 1 Bodhi Algorithm



14: end while



Figure 1. Bodhi Platform Operation Diagram

IV. BODHI PREDICTION MARKET PRICING

Bodhi is committed to creating a free-to-participate, low-cost prediction market. On Bodhi, Oracles serve as judges and BOT holders are maintainers. Incentive (service fee) is provided to the Oracles on the platform to motivate more Oracles to provide credible and stable services for Bodhi.

Equation 1 shows how the rate is calculated. Let F_s be the percentage of the service fee payable to Oracles and F_t be the percentage of the transaction fee payable to the platform. S_{loss} denotes the total loss of all parties that failed the prediction and S_{win} denotes all the gains from all users that succeed in the prediction.

$$S_{win} = S_{loss} \times (1 - F_s - F_t) \tag{1}$$

 F_s and F_t will be dynamically determined in the future as we plan to create a prediction event to let all BOT holders determine the best fees .

V. BODHI TOKEN

The token for Bodhi prediction market is called Bodhi Token (BOT). BOT will be issued during the contract deployment phase, with a total of 100 million units.

In order to ensure the simplicity and independence of platform logic, Bodhi does not issue WIZ tokens like Gnosis. At the initial phase when we take Bodhi online, the Bodhi platform will only support BOT and QTUM. With the rapid evolvement of blockchain technology, stable coins and cross-chain technologies are emerging. In the near future, Bodhi prediction market is intended to be flexible enough to allow the use of any cryptocurrency (which is not a security) to participate in the prediction market.

BOT represents two main interests:

- Arbitration and Compensation. BOT holders are entitled to initiate arbitration for disputed results of prediction events and receive incentives accordingly. Before initiating the arbitration, a BOT holder must lock up certain amounts of BOT as deposit. If the arbitration result is in favor of the BOT holder, the holder is entitled to receive certain amounts of BOT as compensation from the losing party of the arbitration.
- 2) Vote and Incentive. BOT holders are entitled to vote for arbitration results of the disputed prediction events and receive rewards accordingly. Before voting, BOT holders must lock up certain amounts of BOT as deposit. If a BOT holder's vote is consistent with the arbitration's final result, the BOT holder is entitled to receive certain amounts of BOT as incentive from the losing party of the arbitration. In addition, BOT holders may shut down illegitimate and malicious prediction events through the voting procedure.

By definition, BOT is a utility token which may only be utilized on the Bodhi platform. Ownership of BOT carries no rights, express or implied, other than the right to use BOT as a means to enable usage of and interaction with the platform, if successfully completed and deployed.

BOT is a non-refundable functional utility token, does not in any way represent any shareholding, participation, right, title, or interest in the Foundation or any other company, enterprise or undertaking, nor will BOT entitle token holders to any promise of revenue, fees, profits or investment returns. BOT is not intended to constitute securities in Singapore or any relevant jurisdiction.

As part of the operation of the prediction markets on the Bodhi platform, BOT will be consumed as service fee (provided to the Oracles) or as transaction fee (paid to the Bodhi platform). To the extent a secondary market or exchange for trading BOT does develop, it would be run and operated wholly independently of the Foundation (or its affiliates), the sale of BOT and the Bodhi platform.

VI. BODHI REVIEW MECHANISM

Bodhi is a blockchain based free prediction market. However, a free market does not mean that Bodhi is a completely unmonitored platform. It is intended that the Bodhi platform will provide a decentralized review mechanism where BOT holders can vote to eliminate illegal and malicious predictions to protect their interests.

VII. BODHI DEVELOPMENT TIMELINE

Bodhi prediction market token ICO is scheduled near the end of 2017. Qtum testnet deployment of Bodhi prediction market beta version is scheduled around the same time. The MVP, production and premium versions are scheduled to be deployed onto Qtum main net in 2018 and 2019 respectively. Figure 2 shows the detailed development schedule for Bodhi.



Figure 2. Bodhi Development Timeline

Risks

YOU CLEARLY UNDERSTAND THAT BLOCKCHAIN AND VIRTUAL CURRENCIES / TOKENS, INCLUDING WITHOUT LIMITATION ETHEREUM, QTUM, BITCOIN AND BOT, ARE NEW AND UNVERIFIED TECHNOLOGIES THAT ARE BEYOND CONTROL OF THE FOUNDATION OR THE ISSUER (AS THE CASE MAY BE). THE PLATFORM AND THE PROJECT ARE SUBJECT TO THE FOLLOWING RISKS, WHICH YOU EXPRESSLY

ACKNOWLEDGE AND ASSUME:

- (a) Risks associated with the Qtum Protocol Given that BOT and the Bodhi prediction market platform are based on the Qtum protocol and architecture, any malfunction, breakdown or abandonment of the Qtum protocol or architecture may have a material adverse effect on BOT and/or the Bodhi prediction market platform. Moreover, advances in cryptography, or technical advances (including without limitation development of quantum computing), could present unknown risks to BOT and/or the Bodhi prediction market platform by rendering ineffective the cryptographic consensus mechanism that underpins the Qtum protocol.
- (b) Security weaknesses. Hackers or other malicious groups or organizations may attempt to interfere with BOT and/or the Bodhi prediction market platform in a variety of ways.
- (c) Uncertain Regulations and Enforcement Actions The regulatory status of BOT and/or prediction markets, and distributed ledger technology generally is unclear or unsettled in many jurisdictions. It is impossible to predict how, when or whether regulatory agencies may apply existing regulations or create new regulations with respect to such technology and its applications, including BOT and/or the Bodhi prediction market platform. Regulatory actions could negatively impact BOT and/or the Bodhi prediction market platform in various ways.
- (d) Insufficient Interest It is possible that the Bodhi prediction market platform will not be used by a large number of individuals, companies and other entities or that there will be limited public interest in the creation and development of distributed ecosystems (such as the network or the platform). Such a lack of use or interest could negatively impact the development of the Bodhi prediction market platform.
- (e) Execution. There is the risk that the Foundation and the BODHI team may be unable or execute or implement the project as set out herein.

VIII. APPLICATIONS OF BODHI PREDICTION MARKET

A. Financial Tool

Conventional financial market forecasting tools have limitations such as high service costs, professional barrier, poor scalability, limited ability to express, lack of accuracy, low efficiency, etc. Bodhi prediction market overcomes those limitations by providing a more detailed description of economic events, where value and risk assessment can be thoroughly made at both macro and microeconomic level. Therefore, Bodhi reduces service costs, removes professional barrier, improves accuracy and efficiency and scales easily. For instance, for a simple prediction event - What is the opening price for Apple stock at January 1st 2018? - conventional financial market prediction tools need to analyze investment environment, basic corporate information and their finances to calculate investment returns, before giving an incomprehensive prediction result. Using Bodhi, however, the prediction result is calculated by the entire network for better accuracy and efficiency, as well as lowering the cost. The same mechanism can be applied to predict other stocks at any given time.

Finance 金融



Figure 3. Financial Tool

B. Information Management

Information plays a critical role in the development of society where many decisions are made based on accurate and reliable information. In order to obtain accurate information to improve decision-making accuracy, people use a variety of information retrieval methods, e.g., surveys and paid data. However, these information retrieval methods are considered costly and unscalable. Prediction markets can motivate people to provide information proactively. In 1988, professors at the University of Iowa created a prediction market where participants can predict the identity of the next elected US president. Since then, the same market has collated predictions for every US presidential election with a prediction accuracy much higher than the political commentators and the results of public polls. Bodhi enables prediction markets creation as ease. The value flow of the blockchain is becoming a profound foundation for prediction markets. Bodhi make prediction result more accurate due to its decentralized characteristics and large-scale user engagement.

Information management 信息管理



Figure 4. Information Management

C. Insurance

Insurance industry has various effects on society through the way that it changes who bears the cost of losses and damage. Traditional insurance industry typically has long and complex claim process due to its centralized management. The massive agent model that is used to drive the business has introduced high operational cost. Bodhi's decentralized solution is a natural fit to solve these problems. Taking flight insurance as an example, passengers can predict and price the probability of a flight delay before boarding. In most cases, the flight will be on time, so that the tokens will be locked in the smart contract of the prediction event. Should a flight delay occur, the Oracle will write the flight number of the delayed flight to the smart contract. The Bodhi platform will be able to automatically process the claim for the passengers who purchased the flight insurance on the corresponding flight. The entire process is fully automated so that no human intervention is needed. Most of the fund will be used to reimburse passengers and the platform only charges a small portion as transaction fees.

Insurance 保险

Figure 5. Insurance

D. Sports Lottery

The global online sports lottery is a huge market with billions of dollars of regulated market funds. Sports lotteries are highly localized where each lottery market operates individually due to the difference in regulations among the regions. Accessibility is limited in those localized markets where data is isolated and fragmented. Data isolation and fragmentation have limited the accessibility of those localized markets where it is impossible to create new interesting lotteries in a timely manner. Regulation is a double-edged sword. On one hand, data shows that the unregulated lottery market is 10 times of regulated ones, which makes fraud and illegal operation a common regulatory issue of the global lottery market. On the other hand, centralized service is prone to hacking, system failure and other uncertainties from service providers. These uncertainties ultimately result in high cost of creating lottery market and user taxation. It further limits the lottery markets from high user engagement and being free markets. The public has associated the lottery markets with speculation, due to its high risk profile. Bodhi brings an innovative way to solve these problems. Bodhi is an open platform based on blockchain where anyone can be transparently involved. Users can create prediction events without high transaction fees. This free and open platform will greatly improve market liquidity and thus create objective odds.

Sports 运动



Figure 6. Sports Lottery

E. Conventional Prediction Markets

Although conventional prediction markets will still play critical roles and involve in decisionmaking processes in all market segments, we foresee the globalization trends in participating and collaborating in prediction markets. Bodhi is committed to building the next generation decentralized prediction market platform. In the near future, Bodhi will co-exist with conventional pre- diction markets and will gradually serve itself as an infrastructure of conventional prediction markets to lower the operational cost. Bodhi platform provides most if not all logic to implement prediction markets where it creates alternative solutions that allows conventional prediction market to operate on Bodhi's infrastructure. Bodhi significantly lowers the system failure rate and operational cost, and it enables users to enter the market easily.

Traditional prediction 传统预测行业



Figure 7. Conventional Prediction Markets

IX. BOT ISSUANCE PLAN

A. BOT Distribution

BOT will be issued during the contract deployment phase, with a total of 100 million units. Table II and Chart 8 show the allocation plan of BOT. Users will get BOT through airdrop and exchange. Bodhi employees will be granted restricted BOT upon employment. These BOT will be eligible to vest upon the satisfaction of a service condition. The service condition is vested over four years, with the first 20% vested upon the completion of token issuance, second 20% vested on the one-year anniversary of vesting commencement date and the rest of 60% vested monthly thereafter, subject to continued employment.

- 1) Vest 20% BOT after token issuance
- 2) Vest additional 20% BOT in one-year cliff.
- 3) Vest 60% BOT monthly in the next three years

Table II BOT ALLOCATION

BOT Percentage	Allocation	
60%	Issued to community users	
15%	Development and Consulting	
10%	Employee incentives	
10%	Early stage emergency arbitrations locked by Foundation	
5%	Bug bounty	



Figure 8. BOT Allocation

B. Token Sale Fund Allocation:

In case Bodhi foundation sells some BOT, the budget from token sale fund will be allocated for the following purposes by the foundation, see Table III. The budget covers a 5-year period.

Fund Percentage	Allocation
65%	Development
10%	Consulting
10%	Legal
10%	Marketing
5%	Misc.

 Table III

 Token Sale Fund Allocation



Figure 9. Token Sale Fund Allocation

- Development: Prediction market platform is a sophisticated system that consists of a large number of subsystems. Sufficient funding needs to be allocated for recruitment, team building, and research and development.
- Consulting: Prediction markets involve in many areas across different segmentations where domain knowledge is needed for carrying out market analysis. We will allocate funding for consulting domain experts and corporations.
- 3) Legal: Prediction markets are an innovation which is able to disrupt many industries, but is also a highly-regulated area and therefore legal service is needed to ensure the regulatory compliance (in particular, in the areas of gambling and securities law). We will allocate funding for general legal advice and emergency legal services. In this regard, we have instructed specialist counsel in Singapore from Tzedek Law LLC to advise on the BOT token sale.
- 4) Marketing: Branding and marketing operations are important pieces to promote Bodhi to

potential customers for growth. We will allocate funding for promoting Bodhi platform and blockchain industry in general.

5) Miscellaneous: Miscellaneous expenses that exclude all above expenses.

X. SUMMARY

Bodhi is a Qtum based platform that decentralizes the prediction market and enables free flow of valuable information via public wisdom and incentivization. Bodhi leverages the advantages of the state-of-the-art decentralized prediction markets by integrating third-party Oracles via its Oracle abstraction layer and a voting based decentralized Oracle mechanism. We introduce a novel replaceable Oracle framework so that the prediction market is more effectiveness and autonomous. Bodhi is committed to influencing the Chinese prediction markets through global engagement.

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