Augur:
a Decentralized Oracle and Prediction Market Platform

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November 18, 2018

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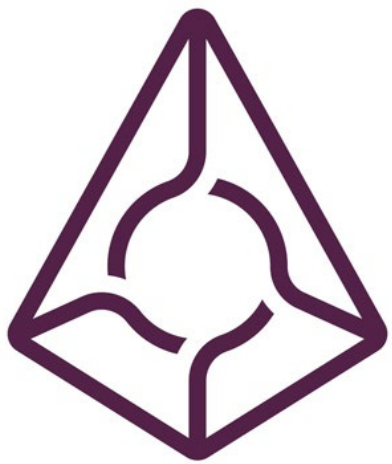
How Augur Works

Introduction

- Augur
  - Trustless, decentralized oracle and prediction market platform
- Decentralized prediction markets
- Centralized prediction markets
  - Global participation
  - Type of market
  - Trust market operator
- Reputation (REP)
  - Market creators
  - Reporters



Life of a Market

Market Creation

How Augur Works

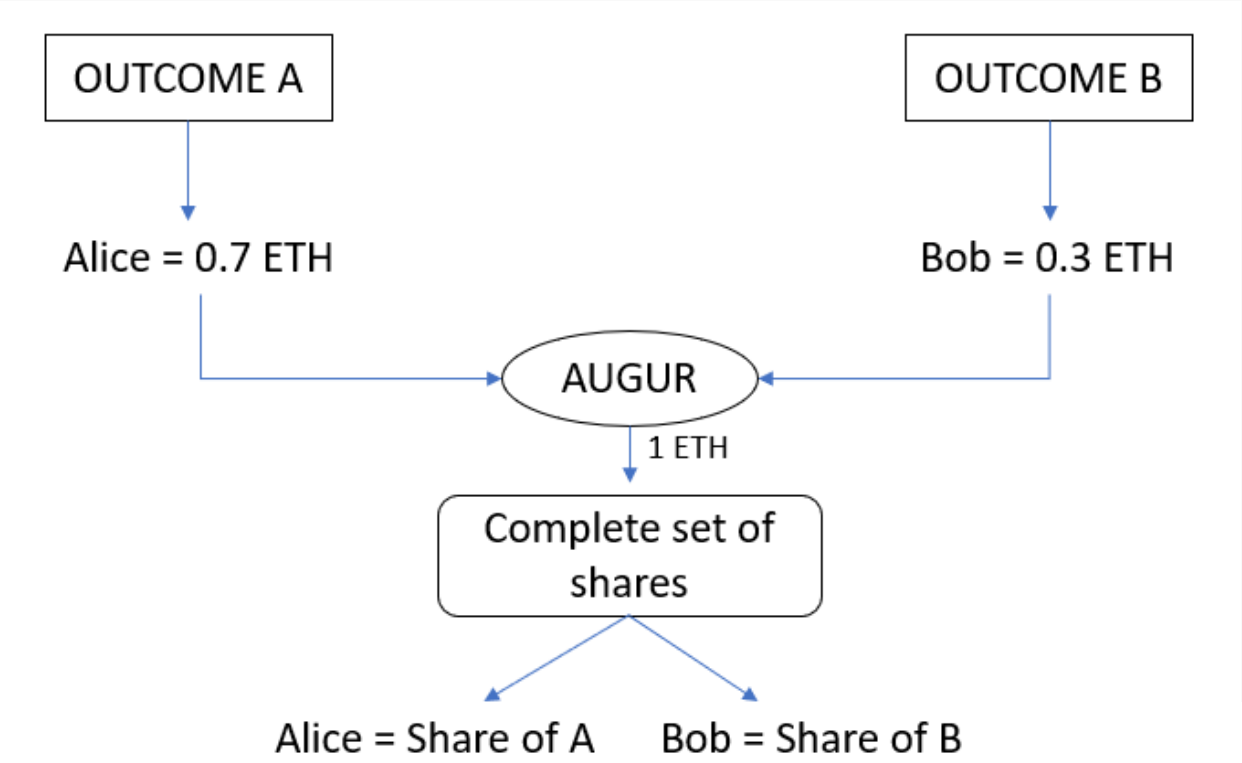
Incentives and Security

Potential Issues and Risks

- Market creator
  - Sets event end time
  - Chooses designated reporter
  - Chooses resolution source
  - Set creator fee
  - Post bonds:
    - Validity bond: ETH
    - No-show bond: REP
- Invalid market

Trading

- Participants trade shares
- Complete set of shares

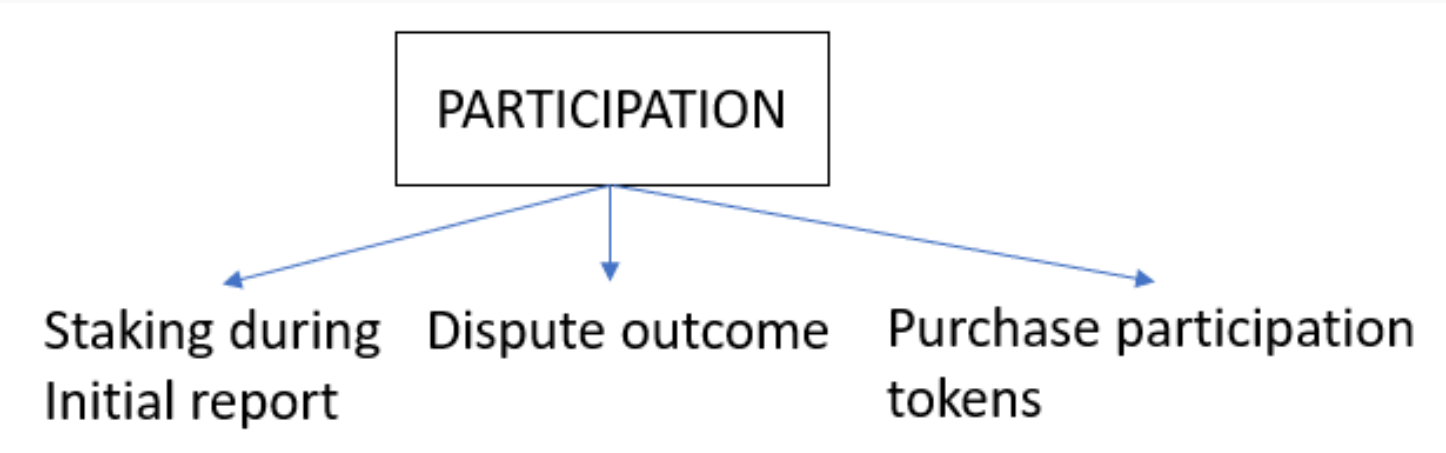


Reporting

- Augur's oracle -> Outcomes (Profit motivated reporter)
- REP owners -> Report and dispute
- Report = Consensus -> Financial rewards
- Report != Consensus -> Financially penalized

Fee Windows

- Augur's reporting system: 7-day long fee window
- Reporting fee pool
- Rewards = REP staked



Participation tokens

- Participation tokens = 10-18 REP
- End(fee window) = Redeem participation token + proportion of fee pool
- Incentive to monitor platform during a few window (7 days)
- Participation ensures:
  - How to use Augur
  - Aware of forks
  - Participate in forks

Market state progression

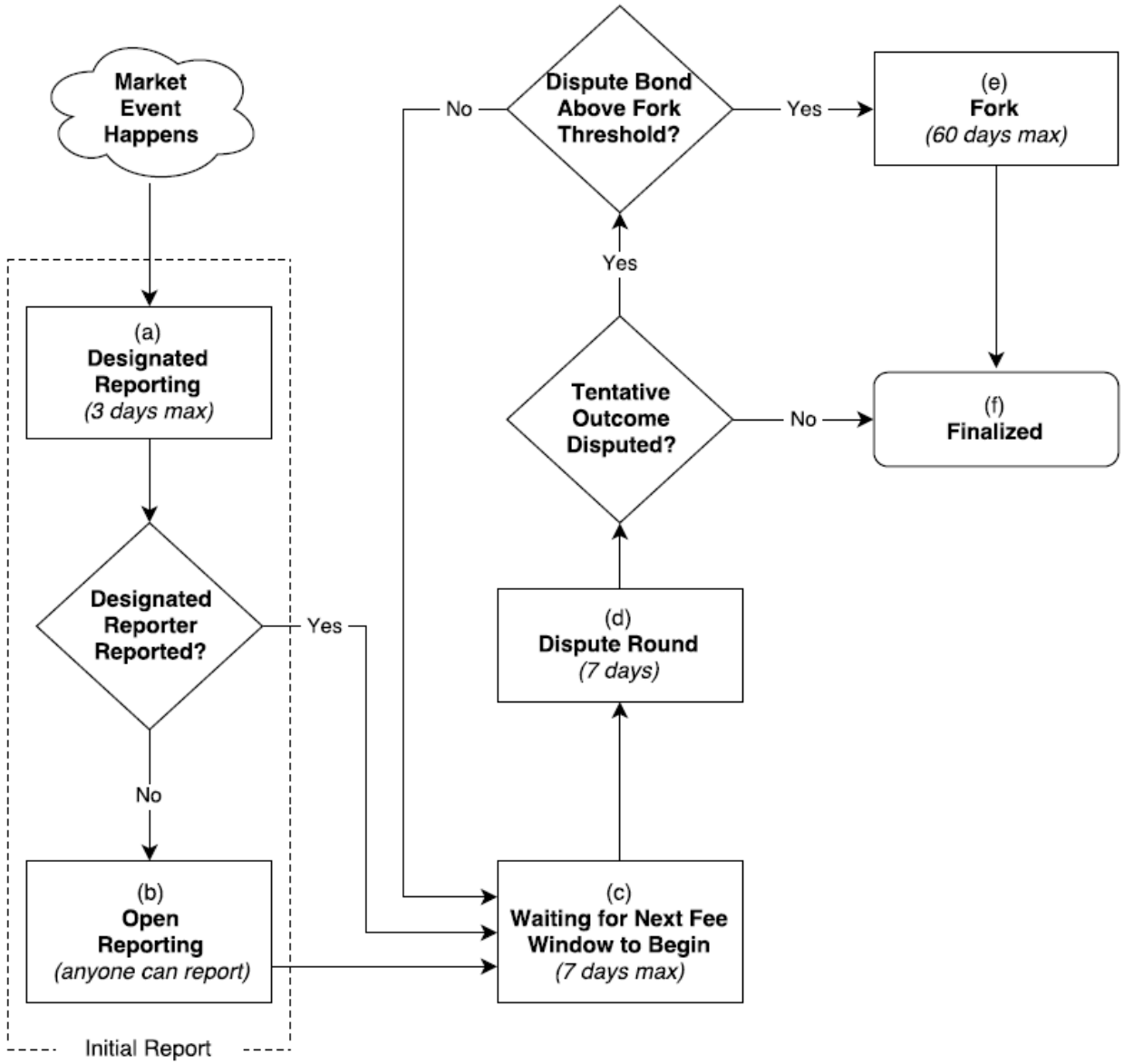
- States of an Augur market:
  - Pre-reporting
  - Designated reporting
  - Open reporting
  - Waiting for the next fee window to begin
  - Dispute round
  - Fork
  - Finalized

Market state progression

[How Augur Works]

[Incentives and Security]

[Potential Issues and Risks]



Market state progression

- Pre-reporting:
  - Begin trading -> Pre-reporting -> Market's event occurs
  - Most active period
  - Event end date -> Designated reporting phase
- Designated reporting:
  - Market creators: designated reporter and post no-show bond
  - Failure to report -> Open reporting phase
  - Reporter posts reporter stake on reported outcome
  - If reporter reports -> Waiting for next fee window to begin phase

Market state progression

How Augur Works

Incentives and Security

Potential Issues and Risks

- Open reporting:
  - Anyone can report on the outcome
  - Market's first public reporter
    - Receives no-show bond
    - No REP needed to report
  - Open reporting -> Waiting for next fee window to begin phase
- Waiting for next fee window to begin:
  - Reporting is on hold till end of current fee window
  - Next fee window -> Dispute round phase

Market state progression

- Dispute round:
  - Dispute market's tentative outcome
  - Dispute stake
  - Successful dispute -> Amount of dispute stake = dispute bond size
  - Dispute bond size:

$$B(\omega, n) = 2A_n - 3S(\omega, n)$$

  - Ensure ROI of 50% -> successfully dispute false outcomes
  - Successful dispute: Another dispute round or fork state
  - If(dispute bond > 2.5%(REP)) -> Enter fork state
  - Else another dispute round

Market state progression

How Augur Works

Incentives and Security

Potential Issues and Risks

- Fork:
  - 60 days
  - Dispute bond > 2.5%(REP) -> forking market
  - Fork begins:
    - Disputing other markets put on hold
    - Fork period > fee window
    - Fork final outcome cannot be disputed

    - “Yes”/“No” market
  - Locked parent universe:
    - No new market
    - Trading shares
    - No reporting rewards
    - Markets cannot be finalized

Market state progression

- Finalized:
  - Pass 7-day dispute round
  - Completion of a fork
  - Outcome of fork -> final outcome
  - Market in finalized state -> final outcome

Market settlement

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Incentives and Security

Potential Issues and Risks

- Close position
  - Selling their shares to another trader for currency
  - Settling their shares with the market
- Non-finalized market: Alice and Bob -> complete set
- Finalized market: Alice
- Settlement fee: Settling with market contract
  - Creator fee
  - Reporting fee
- Alice: 70% of fees and Bob: 30% of fees
- Settlement of invalid markets:
  - N -> possible outcomes
  - C ETH-> Cost of complete set of shares
  - Settlement = C/N ETH
- Reputation redistribution

Incentives and Security

Integrity of the Forking Protocol

It is the credible threat of a fork, and the belief that the fork will resolve correctly, that are the cornerstones of Augur's incentive system.

Integrity of the Forking Protocol

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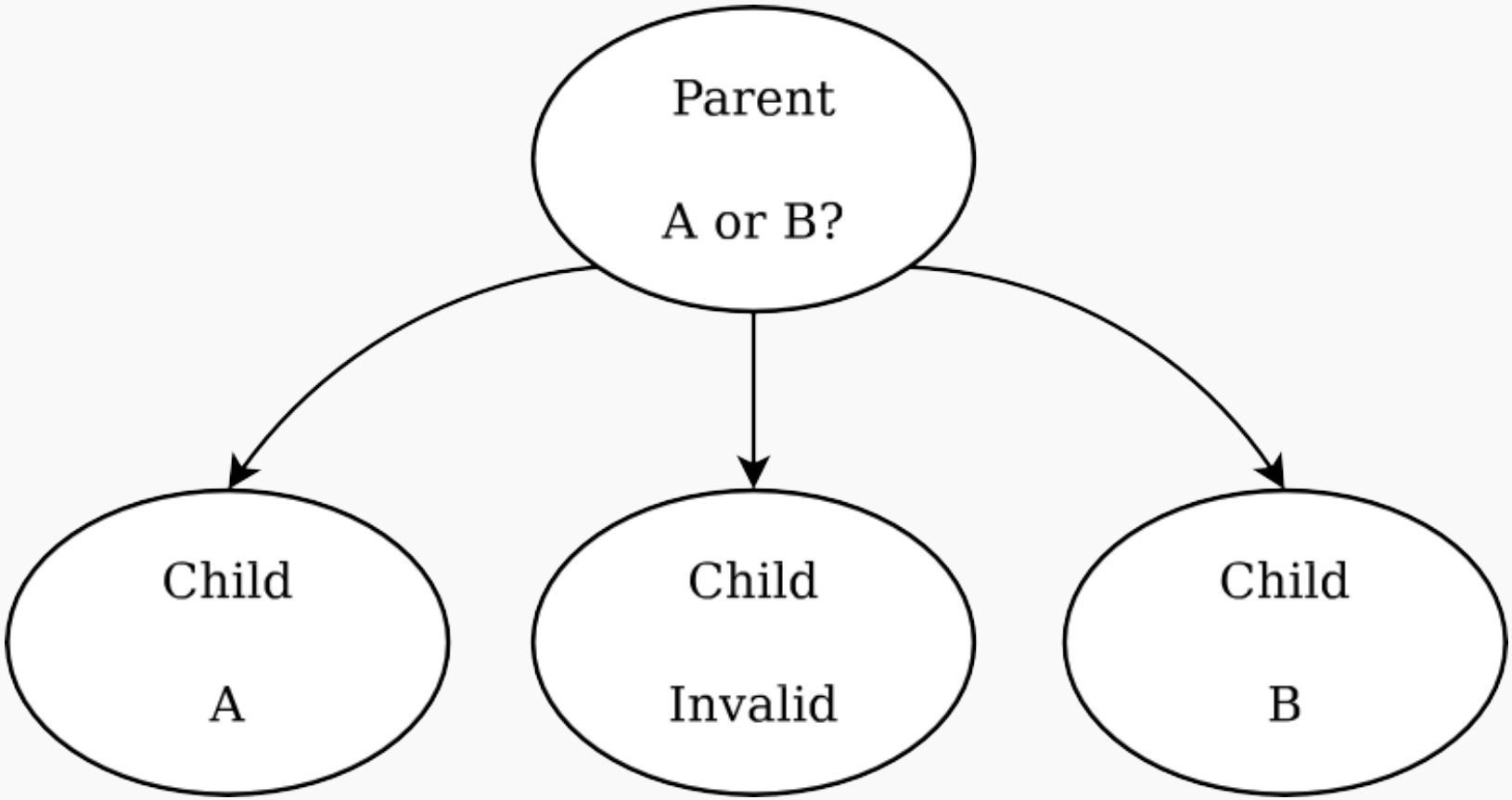
Incentives and Security

Potential Issues and Risks



Integrity of the Forking Protocol

How Augur Works

Incentives and Security

Potential Issues and Risks

- Universe that reflects reality is *true universe*, all others are *false*
- Universe that receives the majority of REP during forking is *winning universe*, all other universes are *losing universes*
- I_a – Sum of all escrowed funds in unfinalized markets (*native open interest*)
- I_p – *Parasitic Open Interest*
- P – Price of REP
- M – Total quantity of available REP
- S – Proportion of M that will be migrated to *true universe* during forking
- SM – Quantity of REP migrated to *true universe*
- PM – Market cap of REP
- P_f – Price of REP in *false universe*

Integrity of the Forking Protocol

(Market Cap Security Theorem) The forking protocol has integrity if and only if:

1. $S > \frac{1}{2}$, or
2. $P_f < P$, and $PM > \frac{(I_a + I_p)P}{(P - P_f)S}$

Assumptions and Consequences

How Augur Works

Incentives and Security

Potential Issues and Risks

- $P_f = 0$
- $S \geq \frac{1}{5}$
- $I_a \geq 2I_p$
- Consequences:

$$PM > \frac{(I_a + I_p)P}{(P - P_f)S} \implies PM > \frac{(I_a + \frac{I_a}{2})P}{(P-0)\frac{1}{5}} \implies PM > \frac{15}{2}I_a$$

Assumptions and Consequences

How Augur Works

Incentives and Security

Potential Issues and Risks

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REP market cap (PM) must be at least 7.5 times the *native open interest* (I_a)

Market Cap Nudges

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Incentives and Security

Potential Issues and Risks

- Reporting fee (for window i): r_i
- Target market cap: t
- Current market cap: c

$$r_i = \max\left(\min\left(\frac{t}{c}, r_{i-1} + \frac{333}{1{,}000}\right), r_{i-1} - \frac{1}{10{,}000}\right)$$

Leveraging the threat of a Fork

- Forks are expensive
- REP is worthless in a *losing* universe
- Users rewarded with 50% RoI for disputing an outcome

Potential Issues and Risks

Parasitic Markets

- Parasitic Markets
  - Don't pay reporting fees, but resolve in accordance with *native* Augur market
- Jeopardize integrity of oracle
- Make trading cheap to combat parasitic markets

Volatility of Open Interest

How Augur Works

Incentives and Security

Potential Issues and Risks

Inconsistent or Malicious Resolution Sources

How Augur Works

Incentives and Security

Potential Issues and Risks

- Attacker is designated reporter and controls the resolution source
- Market is intentionally misreported
- Honest reporters see the resolution source differs from the tentative outcome
- Attacker switches the outcome on the resolution source in the dispute round
- Market can be held indefinitely in dispute rounds
- Honest reporters eventually lose
- **Be wary of dubious reporting sources**

Self-Referential Resolution Queries

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Incentives and Security

Potential Issues and Risks

Will any designated reporter fail to submit a report during their three-day forking period before December 31, 2018?

Uncertain Fork Participation

- Can't be sure users will migrate their REP during a fork
- Expect 20% participation
- 5% additional REP as incentive to move during 60 day forking period

Ambiguous or Subject Markets

How Augur Works

Incentives and Security

Potential Issues and Risks

- ☐ Some questions can't be unilaterally answered
- ☐ Some questions will be debated even after the event occurs
- ☐ Some questions will be structured poorly

Ensure that markets are clear, unambiguous, and clearly decisive in nature.