MEV 101 : How to dive into MEV

Titania Research

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OpenQuestion will be added as needed

Topics

- Open Questions for a systematic understanding of MEV problems
- How to dive into MEV
- Titania Research's open problem

Background

The 3rd MEVTokyoSalon was held on November 21, 2023. Nearly 90 people registered for the event, and nearly 60 people attended at the venue in Tokyo. We also received a lot of feedback on Twitter and felt that it was a very meaningful event where we were able to share our knowledge of MEV.

However, we feel that we were not able to achieve our goal for the event, which was to increase the number of people contributing for Ethereum.

The reason for this is that it requires extensive knowledge to understand MEV, and we did not know where to start researching or getting involved, and we were not able to encourage people to take the next action.

Therefore, we wrote "Open Questions," a list of ploblems related to MEV, as a starting point for people to get involved in MEV.

We hope that those interested in MEV will use Open Questions as a guidepost to take the next step.

MEV are deeply related to the Ethereum block building and are very important for Ethereum to become a GlobalStateMachine. It is not too late to get involved in MEV, and it is a very interesting area that is about to move in a big way.

MEV Basics

Before reading Open Questions, let's start with an overview of MEV to get a good idea of what they are all about.

Below are some articles that you may find helpful.

- MEV: Maximal Extractable Value Pt. 1 https://www.galaxy.com/research/whitepapers/mev-how-flashboys-became-flashbots/
- MEV: Maximal Extractable Value Pt. 2 https://www.galaxy.com/research/whitepapers/mev-the-rise-of-the-builders/

MEV-Boost

Nearly 90% of Ethereum's blocks are built using MEV-Boost. However, each party involved in MEV-Boost has problems. Let's analyze those problems and think about solutions, and if we can see a solution, let's think about how that solution can be used.

Searcher

In MEV-Boost, when the Searcher finds revenue opportunities, it passes those transactions to the builder as a bunlde. Currently, it is necessary to trust that the builder will not unbundle the bundle passed to the builder.

If the bundle is from a high-impact searcher or a bundle with a small revenue opportunity, the incentive for the builder to unbundle is not great. However, there is a good chance that a builder will unbundle a bundle that is highly profitable in a way that the searcher does not know about.

How can you trustlessly trade a bundle that has a particularly large profit opportunity?

- Modular Searcher Design: A Framework for Building Searchers
- IntegrityProof (Flashbots — Best Innovation prize in ETH Global New York)
- Visualization for builders reputation

Builder

In MEV-Boost, auctions are held between builders, and the winning builder's block is passed on to the proposer to be built as an Ethereum block.

However, more than 90% of the blocks built by MEV-Boost are occupied by the top 4 builders, and if the builders become monopolistic, arbitrary rules may be created among the top builders to protect their competitive advantage, making the block building process opaque.

The builder monopoly is a result of the monopoly of the top builder. Why does a block builder monopoly occur, what is the problem, and how can it be resolved?

Reserence (about builder)

- Structural Advantages For Integrated Builders In MEV-Boost
- Builder Market: Now and the Future
- Beyond Extraction: The Role of Block Building in the Future of Ethereum
- Builder Dominance and Searcher Dependence
- Empirical analysis of Builders' Behavioral Profiles (BBPs)
- The Future of MEV is SUAVE

Reference(about blockspace)

- The first profitable blockchain
- Opportunities and Considerations of Ethereum's Blockspace Future
- The Centralizing Effects of Private Order Flow on Proposer-Builder Separation
- Structuring Blockspace Derivatives
- Block vs. Slot Auction PBS

Relayer

The full block constructed by the builder is sent to the relayer. Therefore, the relayer can censor the block. Relayer plays an important role in facilitating block construction in MEV-Boost, but it has high machine-spec requirements and requires a lot of money to operate, while relayer does not receive any revenue sharing.

Is censorship of Relayer all bad, and how can censorship be prevented? What problems will occur if there are no incentives for the relayer, can the relayer's operating costs be reduced, and can the relayer be incentivized?

Reference (Relayer Issues and ePBS)

- MEV-Boost: Merge ready Flashbots Architecture
- Relays are a Latency Game
- State of research: increasing censorship resistance of transactions under proposer/builder separation (PBS)
- Optimistic relays and where to find them
- Relays in a post-ePBS world
- Mike Neuder — Towards Enshrined Proposer-Builder Separation

Reference (Relayer's proposed solution)

- The Pursuit of Relay Incentivization
- Realigning block building incentives and responsibilities — Block Negotiation Layer

ePBS (enshrined PBS) / in protocol PBS

There are two types of PBS: in protocol PBS (sometimes called ePBS : enshrined PBS), which requires protocol modification, and out-of-protocol PBS, which does not require protocol modification. MEV-Boost is an out-of-protocol PBS.

The out-of-pf-protocol is characterized by a fast implementation speed, but as seen in MEV-Boost, it requires some trust. ePBS is a hot topic of discussion in the Ethereum community, as no definitive implementation has been proposed.

The need for ePBS and how it should be done

We have discussed the challenges of MEV-Boost, and there is much discussion about the need to implement ePBS as a solution, especially around Relayer. Let's analyze the current ePBS discussion and make some suggestions. Is ePBS really necessary? And if so, what form of ePBS would be desirable?

Reference (Overall impression of PSS)

- ePBS — the infinite buffet
- Ethereum PBS R&D Roadmap — Mike Neuder
- Why enshrine Proposer-Builder Separation? A viable path to ePBS
- Notes on Proposer-Builder Separation (PBS)

Reference (major PBS proposals)

- Two-slot proposer/builder separation
- Payload-timeliness committee (PTC) — an ePBS design
- Unbundling PBS: Towards protocol-enforced proposer commitments (PEPC)
- PEPC FAQ
- PEPC-DVT: PEPC with no changes to the consensus protocol
- PEPC-Boost
- PEPC-Boost V0
- MEV-Boost+/++: Liveness-first Relay Design

How to handle bid cancellations by builders

In a block auction between builders, if a bid is submitted that is lower than the previously submitted bid, the block with the lower bid is considered the latest block, effectively cancelling the bid.

This is particularly useful for DEX-CEX-arbitrage, and plays a role in increasing MEV revenues and shaping the DEX price. However, it is said that nearly 90% of the bids submitted by builders are unnecessary bids, wasting relayer resources.

In addition, due to latency issues, ePBS proposals are basically considered in a way that does not take bids into account. What are the problems and importance of bidding, and how should we handle bid cancellations in the future?

- Time, slots, and the ordering of events in Ethereum Proof-of-Stake
- Bid cancellations considered harmful
- Time Moves Faster When There is Nothing You Anticipate: The Role of Time in MEV Rewards

MEV-burn

MEV revenues are not distributed equally among all validators, but rather the most profitable blocks are biased. Therefore, if the profitable blocks cannot be proposed, the validators will not be able to earn the expected revenue.

Therefore, MEV-Burn is discussed to return MEV revenues economically and to prevent MEV spike by burning MEV revenues.

However, it is difficult to accurately calculate MEV revenues due to DEX-CEX arbitrage and Intent. In addition, the structure of MEV may have changed when MEV-Burn is introduced due to the possibility that MEV revenues may decrease.

Is MEV-Burn the best solution to the challenge?

- Dr. changestuff or: how i learned to stop worrying and love mev-burn
- Committee-driven MEV smoothing
- MEV burn — a simple design
- Burning MEV through block proposer auctions
- MEV burn: Roadmap After PBS

The whole MEV experience

What to do with bad MEV

There are three main types of MEV earnings: Arbitrage, Liquidation, and Sandwich attack. Among these three, Sandwich attack is called "bad MEV" because it directly disadvantages some entities. There are solutions such as MEV-Share and MEV-Block, which do not make transactions public, but there are data that show that transactions passed to them are more disadvantageous.

What are the causes of bad MEVs? And how can bad MEVs be prevented?

- MEV-Share: programmably private orderflow to share MEV with users
- The False Narrative of MEV Protection: How Private Transactions Can Result in a Poorer Settlement Than Sending Publicly

LVR

One of the indicators to evaluate LPs is loss versus rebalancing. The essence of Loss versus Rebalancing is the outflow of value outside the application due to arbitrage caused by information asymmetry between arbitrager and liquidity provider. LPs are losing money.

What are the causes of LVR? What are the causes of LVR and how can we deal with LVR?

- Ending LP's Losing Game: Exploring the Loss-Versus-Rebalancing (LVR) Problem and its Solutions
- Liquidity Provider Strategies for Uniswap v3: Loss Versus Rebalancing (LVR)
- LVR: Quantifying the Cost of Providing Liquidity to Automated Market Makers

Future MEV revenues and block construction

MEV revenues are expected to decline due to a variety of factors, such as the DEX protocol upgrade, the rise of Intent-Based Applications, and the transition of the Ethereum execution environment from L1 to L2.

What will happen to the MEV market in the future? What will happen to block construction when MEV revenues decrease?

- Distribution of MEV Surplus
- The Future of MEV is the Future of the Crypto — Has the Importance of the MEV Track Been Underestimated?
- MEV Outlook 2023: Walking Through the Dark Forest
- A Deep Dive on MEV Market Structure
- Distribution of MEV Surplus
- MEV Markets Part 3: Payment for Order Flow
- The Orderflow Auction Design Space

Other open questions

- ePBS – the infinite buffet
- Flashbots Research
- RIG Open Problems (ROPs)

How to dive into

If you have read this far, thank you. If you are interested in MEV and want to DIVE INTO MEV, I hope you will practice 1~4.

1. from Open Questions

First of all, let's do some in-depth research on what you are interested in from the Open Questions in this article, as MEVs require a variety of knowledge such as sociology, behavioral economics, financial engineering, cryptography, informatics, and so on. It may be easier to start with an area where you can make use of your background.

1. Summerize your researchOnce you have made some progress in your research, summarize your findings. Also, try to summarize your hypothesis in the course of your research. It would be better if you can write an article about it.

2. Hypothesis testingHypothesis testing is a good way to test your hypothesis. Read additional articles or discuss with others who have knowledge based on the articles you have written.

3. Next ActionSummarize the results of your hypothesis testing and write down your next action. The MEV community is very open, and many people are attracted to the Ethereum philosophy. Therefore, even if you are a newcomer, as long as you have interest and knowledge in the field, everyone is welcome.

When conducting 2~4, you can use EthereumResearch and Flashbot Collective to deepen the quality of your thoughts.

- Ethereum Research : https://ethresear.ch/tag/mev
- Flashbot Collective : https://collective.flashbots.net/

Titania Research

We at TitaniaResearch, also have OpenProblems. If you have found something you would like to work on in MEV and would like to take advantage of Titania Research, please contact a member of Titania and give it to OpenProbrems. We are ready to support you.

We are currently focused on the following development discussions.

- SEPC: is an out-of-protocol “diet PEPC” where proposers register their commitment to SUAVE instead. Already won prize from Flashbots / Uniswap Foundationin the ETH Global Isutanbul hackathon.
- Relay boost (inclusion list or parallel auction): perform builder auction but send tx directly to the relayer to be included in the block in parallel. tx sent to the relayer will be added to the block with the highest bid. Sending tx to relayer in addition to block acuction by the builder can generate new activities and lead to securing revenue for relayer.
- Uniswap X on Suave: We believe that SUAVE has the potential to be used as an execution environment for Intent based applications. As a first step, we will implement direct fill of UniswapX, which currently faces many problems, in SUAVE.

And Also We provide learning opportunities, research and development mainly on mechanism design, etc. so that everyone can start contribution from open source. If you are interested, please contact us.

Contact us

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