

Overview

The past few weeks have been quite eventful with ETHDenver, market volatility, and various announcements. This edition will cover development, research and events from February 10th until March 16th. Due to the sheer amount of content since the previous report, this edition will be the longest yet. I've done my best to keep things succinct and engaging. Enjoy!

MEV-Share: programmably private orderflow to share MEV with users

Just in time for Valentine's Day, [@bert](#) introduced MEV-Share

: a permissionless and private matchmaking protocol between users and searchers. MEV-Share builds on MEV-Boost by further unbundling the transaction supply chain, enabling collaboration between searchers and users.

Through MEV-Share users will be able to receive MEV back by revealing parts of their transactions to searchers through programmable privacy. Searchers will have access to this additional information and bid in an auction for the right to execute against it.

MEV-Share explores how programmable privacy, preference expression, and credible commitments can enable decentralized block building and can be seen as a proto-SUAVE

that can progressively evolve into a fully decentralized network.

We've released the [client library for the MEV-Share Matchmaker](#), featuring examples of programmable privacy and using the MEV-Share endpoint to backrun transactions.

Block Building inside SGX

In the [previous Transparency report](#) I highlighted the work of [@metachris](#) and Frieder Paape of running a prototype of [Geth inside SGX](#) and syncing with Ethereum mainnet.

Fast forward to earlier this month and they have now successfully implemented a fully functional block builder inside SGX. This development marks a significant step towards decentralized block building and reducing the risks posed by exclusive order flow.

Running a block builder inside an SGX enclave allows block builders to create economically efficient blocks without knowledge of the contents of the user's transactions.

On March 3rd when the article was published, the SGX builder was live on the Sepolia testnet, however as of publishing this report, the SGX builder has begun landing [blocks on mainnet

](<https://etherscan.io/block/16813125>)! Blocks built by the Flashbots SGX builder can be identified by the extra_data of the block: Illuminate Dmocrtz Dstrib Prtct

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From [Etherscan

](<https://etherscan.io/block/16813125>)The [Github repository](#) has documentation and an example for running Geth in [Gramine](#), a libOS for SGX enclaves. Join the conversation in the [forum post](#)!

MEV-Boost

All-time high for daily MEV payments to Block Proposers

The market turmoil on March 11th triggered a [surge in on-chain activity](#) and MEV opportunities, resulting in a new daily all-time high for validator payments via MEV-Boost. The total payments made to block proposers amounted to 7691 ETH

, nearly twice the previous record set during the FTX collapse [@bert published a thread](#) looking into the activity that

unfolded and the impact it had on both the Relay and Builder market of MEV-Boost.

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From

[mevboost.pics

](https://mevboost.pics/)

This record breaking amount of ETH being extracted by searchers resulted in many negative externalities and outcomes for users, the most notable example being the bot that made over \$2M from a user that failed to set their slippage limit on a trade, as [described](#) by [@bert](#) and [separately](#) by KyberSwap.

Diversification in the relay market

A considerable diversification can be seen in the relay market with Agnostic Relay and Ultra Sound Relay gaining market share in February and March. In November 2022 the blocks relayed through the Flashbots Relay peaked at ~60-70% of mainnet blocks. That number is now about [25%](#).

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From

[mevboost.pics

](https://mevboost.pics/)

This diversification in the relay market has contributed to a noticeable decrease in the percentage of proposed blocks sourced from non content-agnostic relays. The previous report indicated that [58%](#) of blocks were sourced from these relays, this figure has now dropped to [37%](#)

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From

[mevwatch.info

](https://www.mevwatch.info/)

[MEV-Boost community calls](#)

[@ralexstokes](#) is facilitating MEV-Boost community calls to discuss MEV-Boost and the Relay and Builder implementations. Two calls have been held so far with great turnout and valuable conversations.

[MEV-Boost community call #0

](https://collective.flashbots.net/t/mev-boost-community-call/1348) ([Recording](#))

The first call covered topics including updates on the [Builder-specs](#) for the Capella and Deneb (EIP-4844), and evaluating the readiness of relay and builder implementations. The conversation also focused on ensuring Capella hard fork readiness by coordinating with relay operators for a smooth transition during the hard fork process.

The group then moved to discuss the [Optimistic Relay](#) pull request, which enables bids to come in closer to the end of the slot. This is achieved by the relays not validating the blocks before forwarding them to the proposer, instead relying on collateral being put up by the builder.

[A transcript](#) of the meeting was published by [@apriori](#).

[MEV-Boost community call #1

](https://collective.flashbots.net/t/mev-boost-community-call-1-9-mar-2023/1367) ([Recording](#))

The second call focused on the successful Sepolia hard fork, preparations for the upcoming Goerli hard fork, and necessary preparations for relay operators. Participants addressed block validation concerns and discussed communication channels for monitoring and sharing urgent issues.

The discussion from the previous call related to Optimistic Relay continued with [@mikeneuder.eth](#) sharing the [roadmap for Optimistic Relay](#) with the long-term goal to achieve enshrined PBS. A lively conversation ensued with concerns raised about latency wars, centralization, and collateral requirements.

Once again, [@apriori](#) shared [a transcript](#) of the meeting!

[The third MEV-Boost community call](#) is scheduled for March 30th, 16:00 UTC.

MEV-Boost development

[MEV-Boost v1.5.0

](https://github.com/flashbots/mev-boost/releases/tag/v1.5.0)

A new stable version of MEV-Boost has been released with a focus on ensuring [Capella readiness](#). It will also introduce [getPayload retries](#) which will mitigate the risk of proposers missing their slot solely due to transient network issues. v1.5.0 also includes dependency upgrades, and a transition to Go v1.20.

[MEV-Boost-Relay v0.16.0 -alpha1

](https://github.com/flashbots/mev-boost-relay/releases/tag/v0.16.0-alpha1) (pre-release)

Similar to the MEV-Boost release, MEV-Boost-Relay v0.16.0 will feature [Capella upgrades](#). [Two extra timestamps](#) collected in the block lifecycle will also be added.

[MEV-Boost and Builder spec Capella upgrades

](https://flashbots.notion.site/MEV-Boost-Capella-Upgrades-00cea01704794f6eb4f792c55b69c441)

[The Capella upgrade on mainnet](#) is fast approaching and is now just weeks, not months, away. This follows the successful Sepolia upgrade on February 28 and the Goerli upgrade on March 14. [Comprehensive documentation detailing all Capella-related changes](#) has been published, covering all actors in the MEV-Boost stack, including block proposers, relays, and block builders.

The documentation for [Running MEV-Boost-Relay at scale](#) has also been revised with regards to Capella together with information related to pruning the builder submission table in the Postgres database.

[MEV-Boost Relay data bulk downloads

](https://flashbots-boost-relay-public.s3.us-east-2.amazonaws.com/index.html)The Flashbots MEV-Boost Relay's bulk data downloads have been updated and automated, featuring over 400 million builder bids and more than 610k delivered payloads since the Merge until now.

Capella engine API

The newest Capella engine API includes a noteworthy addition: the local execution client now returns the payload value alongside the payload itself. This improvement will allow the consensus client to compare the locally built block with the block received from MEV-Boost.

As described in the [Transparency Report from November](#), being able to compare the value of a locally built block with the [value of a block from a third-party builder](#) will open up new possibilities that give proposers greater flexibility in how they operate.

As described in [The Cost Of Resilience](#), the validator could for example propose a locally built block if the difference between the block sourced from MEV-Boost and the locally built block is below a certain value, as opposed to deciding only based on the payload value from MEV-Boost with the min-bid parameter.

Research and discussions

[Decentralized crypto needs you: to be a geographical decentralization maxi](#)

In this post [@phil](#) emphasizes the dangers posed by latency games and underscores the necessity for geographical decentralization

. The post examines trends in MEV that have the potential to centralize and weaken the core mission and value proposition of cryptocurrency. The post argues that the most important only exit from a future where power dynamics in cryptocurrency become centralized and predatory is through geographic decentralization. It then explores the relationship withbetween geographic decentralization and privacy, which is presented as the dominant economic phenomenon in the next decade of MEV evolution.

[Backrunning Private Transactions Using Multi-Party Computation](#)

In this article [@ra](#) explores the application of [secure multiparty computation \(MPC\)](#) to enable searchers to backrun users' transactions while maintaining the confidentiality of both transactions and searcher strategies. By utilizing MPC multiple parties can collaboratively compute a public function while keeping their respective inputs private, revealing only the final result.

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MPC-based Backrunning Private Transactions

This MPC setup shares similarities with SGX but differs in that the backrunning program is executed as a communication protocol between the user and the searcher

, rather than as a program within an SGX enclave on the searcher's machine.

If you wish to learn more, check out [@ra presentation](#) during the [MEV Roast on Privacy](#) and see the proof-of-concept with instructions for backrunning private transactions using MPC on [Github](#).

[Proposer Auction Simulations: Ideas Wanted!](#)

[@jolene](#) is seeking ideas on alternative ways to design the market for block construction in MEV-Boost that maximize welfare. The collected suggestions will then be used in models and simulations to gain a deeper understanding of the current PBS market's structure.

Check out the thread and contribute with your suggestions to help us improve the block construction market!

[Multiplicity: A Gadget for Multiple Concurrent Block Proposers \(aka Ending the Proposer Monopoly\)](#)

[@eljhf](#) and Max Resnick expand on their post published on the [Ethereum Research](#) for the context of Flashbots. The post explores ways to enhance censorship resistance in blockchains and introduces [Multiplicity](#) as a practical gadget for allowing multiple concurrent block proposers.

The goal of Multiplicity is presented as a tool to build censorship-resistant on-chain auctions that will enable decentralizing block building and for MEV to be recaptured at the application level. It may also be used to achieve decentralized sequencing for rollups.

[Cross-domain MEV with EigenLayer](#)

In this post [@Walt0x](#) explores potential centralization and neutrality issues that could arise from cross-domain MEV and EigenLayer. It highlights risks like multiblock MEV, and explores mitigation strategies through SUAVE, application design and MEV-smoothing. The post is a shortened version of the original post published on the [EigenLayer forum](#).

[Suave Economic Security Models](#)

In response to [@Jon](#)'s thread, [@Hasu](#) elaborated on the economic security models for SUAVE, noting that while rollups could be a long-term solution, SUAVE doesn't substantially benefit from the safety and liveness guarantees a rollup would provide.

Hasu also emphasized the current focus on innovative transaction types and the programmable privacy framework instead

of the specific architecture used for securing the chain.

[Flashbots Research Proposals \(FRPs\)](#)

Two FRPs have been completed since the previous report with published papers showcasing their results:

[FRP-21: MEV in fixed gas price blockchains

](<https://github.com/flashbots/mev-research/blob/main/FRPs/completed/FRP-21.md>) by [@facuzeta](#)

This research explores MEV opportunities within blockchains with fixed gas prices, focusing on the Terra Classic blockchain from September 2021 to the de-peg event in May 2022. The objectives included analyzing Terra Classic's arbitrage characteristics, comprehending the strategies searchers use to optimize profits, examining timing-related aspects of arbitrage, and creating a dashboard to facilitate data analysis.

- [Paper](#)
- [Forum post](#)

[FRP-22: Quantifying the Impact of Frontrunning and Randomness on UX

](<https://github.com/flashbots/mev-research/blob/main/FRPs/active/FRP-22.md>) by [@awmac](#)

This FRP addresses the question “What happens when your order hits the mempool?”. The developed model offers a probabilistic perspective on mempool dynamics from a trader's perspective on a Constant Function Market Maker (CFMM). The model integrates elements from game theory and queueing theory and is computable under certain conditions discussed in the paper.

- [Paper](#)
- [Blog post](#)
- [Forum post](#)

A new FRP was approved earlier this month: [FRP29: Research on MEV in L2 Blockchains

](<https://github.com/flashbots/mev-research/blob/main/FRPs/active/FRP-29.md>) by Erik Zhang and Cindy Jiang + FranklinDAO (Penn Blockchain) Research Committee, . The research will explore the current MEV landscape, with an emphasis on decentralizing sequencers used by L2s.

Flashbots is an open research organization and anyone can [submit a research proposal](#) and become eligible for a [grant](#)!

[Flashbots at ETHDenver](#)

Flashbots organized a series of MEV and research events at the Pirateship Hackerhouse and other venues during ETHDenver. Recordings of these events can be found below. See the [ETHDenver forum post](#) for additional details and discussion.

- [ETHDenver Privacy Workshop: Boiling the TEE Kettle](#) with [@socrates1024](#), [@phil](#), Kevin Yu and Elaine Shi.
- [MEV \[re\]search-athon](#) with Max Resnick, AC, Tarun Chitra, Tom Schmidt, Amir Bandeali, Danning Sui, [@Quintus](#), Dan Robinson, James Preswich, Dan Marzec, [@bert](#) and [@phil](#).
- [Commitments and privacy in the MEV supply chain](#) by [@bert](#) at ETHDenver.
- [MEV Panel](#) with [@bert](#), Zak Cole, Berry Plunkett, Neel Somani & Guillermo Angeris at the [Shared Security Summit](#).

In order to stay up to date on any upcoming events feel free to subscribe to the [Flashbots Collective calendar](#)!

Resources

Below is a collection of publications, podcasts, dashboards and other resources from the broader community posted since the last report on topics related to MEV, PBS and Flashbots. Check out the list from [previous months](#) for more fantastic resources and please feel free to share additional resources as replies below or in the [bookmark-topics](#)!

ETHDenver

- [MEV Past, Present, and Future](#) by [Joey Zacherl](#) (Rook)

- [MEV and the Limits of Arbitrage](#) by [Lucas Baker](#) (Jump Crypto)
- [The Road to Account Abstraction](#) by [Yoav Weiss](#) (Ethereum Foundation).
- Related: [Account Abstraction-panel](#)
- Related: [Account Abstraction-panel](#)
- [EIP4844 from CL client's perspective](#) by [Terrence Tsao](#) (Offchain labs)
- [#ShareTheMEV: Recirculating value to all the right places](#) with [Matt Cutler](#) (Blocknative)
- [MEV Relays: Dumb Pipes or Something More?](#) with [Alex Nathan](#) (Metrika)
- [Why are cross chain auctions so hard?](#) - [Tarun Chitra](#) (Gauntlet)
- [NFT Auction Design: GDAs and Private Values](#) by [Tarun Chitra](#) (Gauntlet)
- [Overview of MEV and ETH Progress](#) by [@ralexstokes](#) (Ethereum Foundation)
- [Fair MEV Distribution](#) by [Davide Cripis](#) (Ethereum Foundation)
- [Overview of Onchain Liquidity Provision](#) - [Xin Wan](#) (Uniswap)
- [The Impact of Chain Forks and Reorgs on the Security and Performance of Cross-chain Bridges](#) - Kacper Bak (Quantstamp)
- [How to win MEV and trades on Ethereum post merge](#) - [Eyal Markovich](#) (bloXroute)
- [Mastering DeFi Trading, Block Building, and MEV](#) by [Eyal Markovich](#) (bloXroute)

Papers

- [Order but Not Execute in Order](#) by [Tiantian Gong](#) and [Aniket Kate](#) compares the welfare loss of decentralized exchanges under two market designs: continuous limit order book (CLOB) and frequent batch auction (FBA) and propose using FBA as a defense against general order manipulation in decentralized exchanges.
- [An Efficient Algorithm for Optimal Routing Through Constant Function Market Makers](#) by [Theo Diamandis](#) [Max Resnick](#) [Tarun Chitra](#) [Guillermo Angeris](#) presents “an efficient algorithm, based on a decomposition method, to solve the problem of optimally executing an order across a network of decentralized exchanges.”
- [Dynamic, Private, Anonymous, Collateralizable Commitments vs. MEV \(summary\)](#) by [Conor McMenamin](#) provides a high-level overview of a commitment scheme that can be built on top of smart contract wallets to help eliminate MEV.
- [tlock: Practical Timelock Encryption from Threshold BLS](#) by Nicolas Gailly, Kelsey Melissaris and [Yolan Romailier](#) present a practical construction and implementation of timelock encryption, in which a ciphertext is guaranteed to be decryptable only after some specified time has passed. The construction [enables](#) “MEV prevention by mining time-locked transactions [and makes] sealed bid auctions ridiculously easy”.
- [The Ethereum Merge: Eliminating Block Time Uncertainty and MEV Bot Behavior \(brief\)](#) by Matthew Lang explores how the behavior of MEV bots changed as a result of the Merge and the switch to a constant block time of 12 seconds.
- [Multi-block MEV](#) by [Johannes Rude Jensen](#), [Victor von Wachter](#) and Omri Ros looks at how builders on Ethereum use multi-block MEV extraction strategies to secure consecutive block space.

Articles

- [MEV Outlook 2023: Walking Through the Dark Forest](#) by [EigenPhi](#) provides a thorough overview of the MEV space in 2022 packed with metrics and key takeaways going into 2023.
- [Modular MEV: Part 1—The Introduction](#) by [Maven 11](#) gives a high-level overview of MEV, and MEV-Boost before diving into decentralizing sequencers of L2s.
- [How The Shanghai Upgrade Will Impact MEV](#) by [Joel Kahil](#), [Benn Glorfield](#), and [Eli Barbieri](#) discusses the impact of withdrawals on the MEV market, with a focus on liquid staking tokens and arbitrage opportunities between these and Ether.
- [The Espresso Sequencer](#) published by [Espresso Systems](#) gives an overview of the Espresso Sequencer: “a decentralized platform to support rollups in decentralizing”, as well as goals and design principles.

- [Through the looking glass: A cross-chain sealed-bid auction using Aztec Connect](#) by Michael Zhu discusses a novel cross-chain approach for implementing private and trustless sealed-bid auctions using Aztec Connect.
- [MEV Series Part I: Blockspace Markets Across Ecosystems](#) by [Natalie Mullins](#) is the first part of a multi-part series where the author sets out to compare various MEV solutions across different blockchains and how these might evolve going forward.
- [Encrypted Mempools: MEV & Censorship](#) by [@jon](#) break down the concept of encrypted mempools as a tool to address MEV and censorship in blockchains.
- [Time boost: a new transaction ordering policy for Arbitrum \(discussion\)](#) is a proposal that introduce a priority fee alongside the existing FCFS ordering approach within the Arbitrum sequencer.

Posts & threads

- [Latency arms race concerns in blockspace markets](#) by [Davide Cragis](#) discusses the risk of the blockspace market replicating market distortions seen in traditional finance, specifically the latency arms race.
- [SCAM Mechanism for Subgame Credible anti-MEV](#) by [Matt Stephenson](#) is mechanism for subgame credible anti-MEV that penalize “Retroactive Public Harms”.
- [CoWSwap](#) published [a thread](#) digging into the ENS DAO [sell order of 10,000 ETH](#) to 16M USDC in a single trade. For additional details and takeaways see the threads by [AI N](#) and [Poolpi](#).
- [Guang Wu shares their experience](#) of discovering MEV, provides insights into the size of the MEV arbitrage market and highlights Rook’s Keeper bot for automated market making.
- [Will Sheehan](#) posted [a thread](#) looking into the de-pegging event of USDC and the on-chain turmoil that followed over the weekend.
- [EigenPhi](#) follows up with some [examples](#) of successful, high-value strategies that took place as a result of USDC losing its peg.

Podcasts & Videos

- [MEV: The Impact on #DeFi Part 2 \(Part 1\)](#) with Dr. Sophie Liu, Mark Richardson and Oscar D Porson to discuss how the MEV landscape evolved in 2022 and its impact on DeFi today.
- [Bell Curve - MEV: The Economic Driver of Blockchains](#) with Jason Yanowitz and Michael Ippolito and guest Nitesh Nath, Xave Meegan and Maghnus Mareneck discuss MEV in Appchains, PFOF, MEV value accrual, cross-chain MEV, wallets and more.
- [The Lab Unplugged: Interchain MEV](#) explores MEV within Cosmos, including the challenges, opportunities and a comparative analysis with the Ethereum landscape.
- [MEV and Fair Ordering](#) with Valeria Nikolaenko and Dan Boneh during The 13th BIU Winter School on Cryptography gives an overview of MEV, MEV-Boost, SUAVE and various ways transactions can be ordered.
- [Decentralized Exchanges, Sandwich, Arbitrage](#) by Arthur Gervais also also during BIU Winter School dives into various designs of DEXes, impermanent loss, sandwich attack, arbitrage and more.
- [Overview of MEV and ETH Progress](#) with [@ralexstokes](#) gives an overview of the MEV market on Ethereum and how things are evolving.
- [The Great High Frequency Debate](#) will be hosted on Friday with [Max Resnick](#), [AI N](#), [Malleh Pai](#), [Uri Klarman](#) and [Davide Cragis](#) to discuss high-frequency trading and latency wars in decentralized finance.

Dashboards

- [MEV Relay Dashboards and Alerts](#) by [Mevtrika](#) provides real-time metrics and notifications to help monitor MEV-Boost Relays for Builders, Relays, and Node Operators.
- [Builder Landscape](#) by [Rated](#) provides metrics of the builder market, including data on exclusive order flow.
- The data behind [mevboost.pics](#) is now open source with info on every slot since the Merge, MEV-Boost and the mapped block Builders, Validators, and Relays.
- The [Ultra Sounds Relay dashboard](#) have introduced a section for censorship with metrics on MEV-Boost relays and block proposers.

Other

- [The Auction Zoo](#) by [a16z](#) is a Solidity implementation of a sealed-bid auction in an effort to “bridge the gap between auction theory and practice by showcasing Solidity auction implementations that demonstrate interesting theoretical properties or novel constructions.”
- [mev-bibliography](#) by [@mikeneuder.eth](#) is a collection of links related to MEV-Boost, PBS, censorship resistance, metrics, MEV infrastructure and more.

Get involved

At Flashbots, we research and build systems around MEV, and we would love to collaborate with you. We are a distributed organization with the principles of a [pirate hacker collective](#), and we have several [open positions](#). We also issue grants to external researchers doing work aligned with ours, please find out more in our [Research repository](#).

Make sure to also look around on our forum and join the conversations!

[Previous Transparency reports](#)