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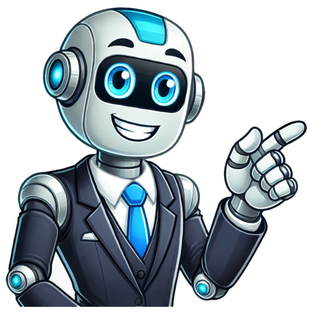

Check out the top 5 RWA tokens that could grow big by 2025. These tokens have the potential to multiply your investment.Prasanna PeshkarDecember 29, 2024 7:30 AMImagine finding an investment that could multiply your money by 1000 times! Real World Asset (RWA) tokens are gaining attention for their potential to do just that. These tokens connect digital assets with real-world value, opening up exciting opportunities in the world of cryptocurrency. In this article, we'll explore the top 5 RWA tokens that could bring huge returns by 2025. Whether you're a seasoned investor or just starting, these tokens are worth keeping an eye on!Top 5 RWA Tokens1. Ondo (ONDO)Ondo Finance bridges traditional finance and the crypto world by tokenizing fixed-income assets, offering investors a stable and innovative way to generate returns. Its unique approach provides exposure to traditional financial instruments while leveraging the transparency and efficiency of blockchain, making it a standout choice in the growing RWA space.A key feature of Ondo Finance is its managed vault strategies, which allow users to deposit assets and earn yields through various DeFi protocols. These strategies are optimized for competitive returns and effective risk mitigation, offering reliability in a market often characterized by unpredictability. Additionally, Ondo's tokenized fund model enables diversification across multiple asset classes, reducing reliance on single markets and enhancing portfolio stability.As the adoption of tokenized assets accelerates, Ondo Finance is well-positioned to attract investors seeking steady yields and diversified growth. With its robust infrastructure and focus on risk management, Ondo offers a compelling option for those looking to blend the best of traditional and decentralized finance in 2025.2. MANTRA (OM)MANTRA (OM) is a cutting-edge DeFi platform and Layer 1 blockchain designed to tokenize and trade real-world assets with a strong focus on regulatory compliance. Built on the Cosmos SDK, it supports CosmWasm and IBC compatibility, ensuring scalability of up to 10,000 transactions per second. This robust infrastructure, combined with a sovereign Proof-of-Stake validator set, offers a secure and efficient environment for developers and institutions. MANTRA's ecosystem includes pre-built decentralized applications, partnerships with on and off-ramp providers, and user-friendly tools like SDKs and APIs to streamline the creation and management of compliant RWAs.With a focus on onboarding non-native users and institutions, MANTRA balances decentralized finance benefits with compliance and risk management. Its scalable, permissionless blockchain tailored for permissioned applications bridges the gap between traditional finance and Web3. As the tokenization market grows, MANTRA's innovative approach, regulatory alignment, and ecosystem strength position it as a leader in the RWA space, offering investors a secure and scalable solution for long-term value.3. Hedera (HBAR)Hedera (HBAR) continues to position itself as a leading platform for decentralized applications (DApps), with unmatched speed, efficiency, and sustainability. Recent advancements, such as the HBAR ETF filing and Ethereum Virtual Machine (EVM) integration, enhance its smart contract capabilities and drive adoption in decentralized finance. Its partnership with LayerZero strengthens cross-chain interoperability, further solidifying Hedera's pivotal role in the Web3 ecosystem.A groundbreaking development in 2024 has added another layer of significance to HBAR's potential. In collaboration with EQTYLab, NVIDIA, and Intel, Hedera now supports Verifiable Compute, the first hardware-based solution for governing and auditing AI workflows. All AI computations on compatible Intel CPUs and NVIDIA GPUs will be immutably recorded on Hedera's network, showcasing its ability to secure next-generation technologies. This integration positions Hedera as a cornerstone for AI and blockchain convergence, opening new doors for adoption and innovation.With the combined momentum of enterprise-grade performance, AI integration, and institutional interest driven by the HBAR ETF, Hedera's future looks brighter than ever. Its scalable and secure infrastructure, coupled with a growing ecosystem, makes HBAR a compelling investment for 2025, catering to both blockchain and AI-focused industries.4. EthenaEthena has carved out a unique niche in the Real World Asset (RWA) tokenization market by combining the stability of gold with the flexibility of blockchain technology. Its innovative hybrid digital asset model offers crypto investors and traditional investors a secure store of value and a hedge against market volatility. By pegging its stablecoins to the value of gold, Ethena ensures price stability while retaining the advantages of decentralized finance (DeFi), making it an attractive option for those seeking both security and innovation.The platform's use of smart contracts adds another layer of appeal by automating transactions and reducing the risk of human error, which is a common concern in traditional finance. Ethena's integration with DeFi protocols further enhances its utility, allowing tokenized gold to be used as collateral. This capability provides investors with new opportunities for earning yield while maintaining exposure to a stable and historically trusted asset like gold. Such features align Ethena with the growing demand for versatile and secure digital assets.As the RWA tokenization market continues to expand, Ethena's hybrid approach positions it as a leader in bridging traditional and digital assets. The growing interest in tokenized gold reflects the increasing need for stable investment options in uncertain economic times. Ethena's ability to combine blockchain's transparency and efficiency with the security of gold-backed assets makes it highly appealing for a broad range of investors.In 2025, Ethena is likely to gain further traction as both retail and institutional investors seek reliable and innovative solutions in the evolving crypto landscape. With its focus on automation, stability, and integrated DeFi opportunities, Ethena's RWA tokens present a strong case for inclusion in diversified portfolios aiming for long-term growth and risk mitigation.5. Maple (MPL)Maple Finance (MPL) has established itself as a transformative platform in the decentralized finance (DeFi) space by bridging traditional credit markets with blockchain technology. Its innovative approach to tokenizing corporate debt provides businesses with new financing options while creating unique investment opportunities for institutional and high-net-worth investors. By focusing on unsecured loans backed by real-world assets as collateral, Maple opens doors for creditworthy institutions to access capital efficiently, addressing a critical gap in traditional finance.Maple's lending pools cater to a diverse range of users, including corporate treasuries and credit funds, making it a versatile platform for institutional lending. The use of smart contracts for loan agreements and automated credit assessments enhances transparency and reduces inefficiencies, offering a secure and efficient way to manage debt financing. These technological advancements set Maple apart as a leader in modernizing credit markets while maintaining a strong foundation in traditional finance principles.As decentralized finance continues to evolve, Maple's focus on institutional lending and unsecured loans positions it to capitalize on the increasing demand for blockchain-based credit solutions. The tokenization of corporate debt aligns with the growing trend of integrating real-world assets into DeFi ecosystems, providing MPL tokens with a compelling use case in diversified investment portfolios.In 2025, Maple is likely to see expanded adoption as more institutions recognize the benefits of its efficient, transparent, and scalable lending solutions. The platform's ability to cater to corporate needs while leveraging blockchain's automation and security could drive substantial growth in MPL token value. For investors seeking exposure to the intersection of traditional finance and DeFi, Maple (MPL) presents a promising opportunity for long-term returns.Article ByPrasanna Peshkar is a seasoned writer and analyst specializing in cryptocurrency and blockchain technology. With a focus on delivering insightful commentary and analysis, Prasanna serves as a writer and analyst at CryptoTicker, assisting readers in navigating the complexities of the cryptocurrency market.Stay up to date with CryptoTicker. Today, I want to talk about spot aggregators and toxic-MEV protection. In detail, I want to explore 4 themes:How are the respective aggregation spaces looking on Solana & EVM today?What are the differences we see among EVM aggregators and what conclusions can we draw?How are aggregators valued?What does this mean for Solana?Let's first set the stageWhy care about MEV? MEV continues to be a major topic in the space and heavily affects UX for newbies (the OGs are still affected, just got used to it by now) — Solana MEV, based on Jito tips, is about $300-$500m annualized in validator tips and actual searcher profits are expected to be 3–4x larger. Although predominantly trading topic, it reaches further out and can affect network performance (think recent Solana congestion caused by bot spamming).Given the general fragmentation of markets we have in DeFi, I like aggregation and find it an interesting topic to explore before diving deeper into MEV. To understand the type of MEV this discussion will revolve around — all MEV will be related to toxic MEV — sandwiching, front & back-running, not healthy arbitraging, which aligns prices across the market.Aggregation spaceOn Solana, aggregation space is simple, it's dominated by Jupiter — beloved brand with its performant smart order routing mechanism, cat-loving founder, and absolute dominance in terms of volumes. Yet, it doesn't fully protect against toxic-MEV, which has become an issue with all the memecoin trading and boosted Solana activity.Source: be fair, Jupiter does a lot to reduce MEV-attack vectors for its users. They split orders into smaller sizes and statistically optimize slippage, reducing MEV profitability. In April, the team also implemented an option for users to automatically add Jito tip to their transactions, which will route transactions via Jito bundles directly to validators as opposed to public RPCs that can potentially leak information to searchers.Yet, Jupiter's solution is not comprehensive as users have to trust validators that they act honestly and are not side-dealing with searchers. Adding Jito tips is an additional cost imposed on users and although the minimum Jito tip is only $0.00015, the current SOL 5,000 daily validator tips and 85,000 daily tippers, assuming $150/SOL, shows that the average tip is around $8.8, which can quickly add up.On EVM (and in this instance, EVM means only Mainnet), the space is quite different — there is a number of players with varying routing mechanisms and MEV protection set ups, competing for space. Probably the most comprehensive Dune dashboard I came across (shows 13 key aggregators in the space. Defillama lists 40 but the 13 here cover the key players, so in this article, I zoom in on the key 13.Of the 13, I will only consider the ones with traded tokens, which leaves me with a list of 8 — Yield Yak, Paraswap, 1inch, Kyberswap, Tokenlon, CoWswap, DODO, and 0x.Source: Coingecko, Defillama, Dune Analytics1inch continues to be the largest aggregator with over 56% market share, followed by 3 close contenders — Paraswap (12%), CoWswap (11%), Kyberswap (10%), then followed by the rest.Source: Dune AnalyticsIn total, 1-month volumes (June 2024) for EVM aggregators come out to $11.5bn, less than 1/2 of Jupiter's $28.2bn over the same period! Undoubtably driven by memecoins (Jupiter's volumes grew 30x since Dec'23), these volumes are real and revenue-generating for a number of market participants (eg. pump[.]fun's $50m revenue inception to date).Source: Defillama, Dune AnalyticsMajority of the players implement some type of MEV protection — RFQ (request for quote) systems, MEV protective RPCs (Flashbots), or slippage modeling.Slippage modeling generally incorporates slippage statistics into the smart order routing algorithm to deliver the optimal trade route. By optimizing (and minimizing) slippage, there is less room for arbitrage and MEV. Slippage modeling is not sufficient though.MEV protective RPCs are for example Flashbots' RPC or CoWswap's MEV blocker RPC, which use various mechanisms (eg. routing via private mempools or back-running user transactions to return the MEV back to users) to eliminate MEV or return the MEV extracted back to the users. MEV protective RPC connections are out-of-app services, which creates unwanted external dependencies and burden users who need to switch to appropriate RPCs manually.This leaves us with RFQ. The actual implementation is quite different for each dapp, but we can differentiate thanks to user behavior.Under traditional RFQ model, users request from participating market makers the best price for their swaps. The main concern? Market makers generally support limited number of tokens and in case of long-tail assets, may either refuse or add high spread to quote the price. As such users are limited to majors. That changes with the more unique concepts of 1inch Fusion & CoWswap.CoWswap was by far the first protocol to recognize the need for application-level MEV protection and continues to be by far the largest RFQ DEX, despite 1inch (largest EVM aggregator by volume) launching Fusion or Uniswap (largest EVM DEX) launching UniswapX in 2023. CoWswap covers around 80% RFQ market share, with little variability.Source: way CoWswap operates to prevent MEV is simple: aggregate bunch of intents to transact, try to settle them atomically against each other if possible (i.e. match someone selling USDC for ETH with someone selling ETH for USDC), and if not, run an auction on the batch for solvers (bots finding optimal solution with the best price and profit for the bot).Source: in the batch also receives the same price — eliminating sandwiches or other types of MEV. Since bots are the ones figuring out the best execution, they take on the risk of MEV, not the users, and CoWswap therefore protects against harmful MEV.Differentiation in a saturated spaceCoWswap and Tokenlon (both RFQ platforms) have by far the largest average trade size — CoWswap $26.2k per trade and Tokenlon even $43.1k! In comparison, 1inch has only $5.1k average trade size — the difference: user profile.Source: retail user knows both 1inch and CoWswap, but if you trade in size, you go to CoWswap. What plays role is the user sophistication (the 'old' retail vs institutional) and human nature. There is a difference if you swap and get sandwiched $1 on $100 trade vs $1,000 on $100,000 trade. Same slippage in terms of percentage points but the absolutes matter in our mental ability to stomach it.My main conclusion from looking at the EVM aggregator space: aggregators have different target user profiles based on MEV-protection mechanisms and different participants cater to different user segments. This is why the space is able to accommodate number of different players with largely commoditized product.Let's talk about valuationIn my mind, aggregators should be valued based on their volumes, that's all that matters and can be monetized. Although, when we look at correlation between token price and aggregator volume, the market disagrees with me — on average there is only 46% correlation!Source: Coingecko, Dune AnalyticsUnderstanding that FDV is a flawed metric without fully unlocked token supplies, let's compare how much people are willing to pay in FDV for each $1 in volume (remember, this is on a monthly volume scale) — FDV/Volume.The range from our observable set is between 0.02x (Paraswap) and 1.05x (DODO). Excluding these extremes, we start to center around 0.2x — 0.3x.Source: Coingecko, Dune AnalyticsPeople are therefore willing to pay $0.2-$0.3 on average for each $1 in monthly volume. Historically, the 25th percentile of data is closer to $0.1 and larger variability on the 75th percentile closer to $0.3 with spikes in 2021 (undoubtably driven by token launches during peak bull market).Source: Coingecko, Dune AnalyticsComing back to the correlation of FDV to volumes, let's look at the overlay for our EVM aggregators. Regardless of volumes, the tokens seem to be down only (hurray for Kyberswap, which is the only player holding).Source: Coingecko, Dune AnalyticsIs this caused by the inability of aggregators to properly monetize due to largely undifferentiated product? One is for certain — only two aggregators with some level of FDV recovery are Tokenlon and CoWswap, the two protocols differentiated by serving large-size transactions. There is some premium associated with ability (or willingness) to monetize as Tokenlon, the largest revenue generating aggregator ($5.2m annualized) has the second largest FDV/Volume of 0.74, 4x of CoWswap.Source: Coingecko, Dune AnalyticsIn aggregate, FDV is ranging from $4m to $590m but most have experienced drops in FDV of 80–90% since their ATH. When assessing the data, I come to 3 findings:FDV is down from ATH 80–90% for most while volumes are down only 50–60% from at-ATH FDV.CoWswap is the only one with higher volumes than at at-ATH FDV volumes while FDV is down 82%.Kyberswap is the only one with FDV falling less than volumes.From the 3 findings, we can draw some conclusions:Either market overshot the valuations in the first place (plausible) as most ATH were hit in 2021 bull or is not properly capturing changes in volume.CoWswap could be a buy opportunity as the market is not pricing in its relative strength. One important caveat is that CoWswap is the only token from the set with a very low float, which is what may be pushing its price down despite volumes.Kyberswap could be a short opportunity for the same reason CoWswap is a buy.So what does this all mean for Solana?Before diving more into Solana, an important consideration is how MEV works. On EVM, toxic MEV is much easier to understand due to the discrete block building mechanism of the L1 and the existence of in-protocol public mempool. Transactions arrive to a mempool where block proposers select and order transactions as they see fit before bribing the block leader to take their block for chain inclusion. Quality of the searcher (aka profit it can generate from the transaction selection and ordering) correlates with their likelihood of winning the bidding war as they can offer higher bribe to the leader over less profitable block proposals from others. Transaction selection and ordering to generate MEV profit is relatively simple to understand.On Solana though, block building is a continuous process at significantly higher speed with no in-protocol mempool in existence. After Jito deprecated its out-of-protocol mempool, which slowed down transaction processing for 200ms and allowed typical MEV attacks and transaction ordering, there is no easy way on Solana to launch attacks. Attackers need to be close to validators or RPC nodes (side-dealing) to receive the most accurate state of the network while also observing incoming user transactions. These key differences in the heart of the blockchain create completely new dynamics in the MEV space.Coming back to the overall market, the spike in Jito MEV tips (the best way to measure SOL MEV activity at the moment) shows how much MEV there is as it points to how much a) searchers are willing to pay extra to validators to prioritize their transactions to make profit or b) users are trying to avoid being taken advantage of and trusting validators to order transactions as they come.Source: The BlockSimilarly, large order size activity continues to grow on Solana — in 2023, there were only 9 weeks in which any single trader transacted over $1m in a single trade on Jupiter, while 2024 YTD, we are seeing significantly more size and frequency of trades. In fact, in 2024, average trade size for traders with more than $1m orders is $2.8m!Source: Dune Analytics private queryTo my earlier point, large size traders will look for ways to minimize exposure to MEV and Solana is not ready for it. This month, Pyth launched express relay (RPC) to shield from MEV and it's a great start that shows Solana is taking notice of the issue. Yet, Pyth solution is out-of-dapp (remember the earlier discussed ways to protect from MEV) and as any veteran developer will tell you, eliminating external dependencies is key.The question that inevitably comes to mind is if Solana needs its own CoWswap — a DEX that will provide the safest trading experience. Jupiter and Pyth — major Solana companies are both offering solutions that are looking to reduce negative MEV. I would argue that larger and sophisticated traders will always look for ways to minimize slippage and as such, there should be an opportunity to capture market share. Looking at Jupiter data, the proportion of trades with USD value above $100k has been steadily growing since 2023 as a percentage of total Jupiter weekly volume, recently reaching as high as 16% before settling down at 7%. But that's still more than the 0–1% at the same time in 2023!Source: Dune Analytics private queryIn 2023, there was also a very limited number of whale trades with sizes larger than $1m, while in 2024, we see a spike with volumes of >$1m trades make up 0.5% of the total Jupiter weekly traded volume.Source: Dune Analytics private queryIn absolute terms, the immediate market opportunity for a CoWswap-like DEX on Solana is all of >$1m trades, which make up $49.5m in weekly volume ($2.5bn annualized) and given CoWswap's average trade size of 26k, we could be even more optimistic and expect the immediate market opportunity to be >$100k trades, which would be around $500m in weekly volume — 10x of the >$1m market.In comparison, $500m weekly-volume DEX would be the 4–5th largest DEX on Solana, fighting for the 4th spot with Phoenix, the high-performant CLOB and only behind — Raydium, Orca, and Meteora.So who is recognizing this opportunity?Actually 2 companies — DFlow (and Urani (, but that's a story for another time. Choosing the right DEX aggregator depends on what you value most: pricing efficiency, cross-chain execution, MEV protection, or API flexibility. With dozens of options available, we benchmarked leading platforms across routing architecture, supported networks, swap fees, and security guarantees.This comparison is for users who already rely on aggregators and want to optimize for specific use cases or chain environments. The table below highlights the top performers and where each one fits best: 70+ chains incl. Solana, Cosmos Bridge + DEX routing, gas abstraction Audited, fallback routing Meta-aggregator, no added fees Open-source, privacy routing Gasless, DCA, limit orders No fees, slippage control ETH, Arbitrum, zkSync, more Fusion mode, partial fills 30+ chains incl. Starknet Ultra mode, DCA, bridging Permit2, audits, MEV rollout Gasless intents, solver auction MEV Blocker, bonded solvers 1. Rango ExchangeRango Exchange sets the standard for decentralized exchange aggregation in 2025 by offering the most comprehensive cross-chain swap infrastructure in the market. It connects over 70 blockchains and pulls liquidity from 100+ DEXs and 20+ bridges to give users the best possible trading rates across networks.Unlike most aggregators that operate within a single blockchain family, Rango supports a wide mix of ecosystems; from Ethereum and Solana to Bitcoin, Cosmos, Tron, and more. Its routing engine automatically handles multi-hop, cross-chain transactions in one click, making it the most versatile tool for all DeFi users.As of its latest security posture, Rango has completed two independent audits and implemented fallback routing to ensure swap completion. With over 4.54 million transactions processed and growing institutional adoption, it's the most complete aggregator for serious cross-chain users.Platform Highlight:Chains: Ethereum, Solana, Bitcoin, Cosmos, Tron, and 70+ othersFees: Free Swaps and 0.15% for Cross-Chain SwapsToken Utility: $RANGO (upcoming) will support governance and ecosystem incentives2. LlamaSwapLlamaSwap has become a go-to DEX aggregator for EVM chains, delivering efficient trade execution by sourcing routes from multiple top-tier platforms. Its no-fee structure and simple interface make it ideal for users seeking better rates without added complexity.Rather than using a single routing engine, LlamaSwap evaluates liquidity across various aggregators like 1inch, CoWSwap, ParaSwap, and Matcha. This broader reach gives traders more accurate pricing, while its built-in privacy mode prevents IP and wallet data from being linked.The platform stands out for its optional privacy mode, which prevents wallet addresses from being linked to user IPs, a critical feature for advanced users concerned with data exposure. LlamaSwap also improves pricing transparency by showing verified gas costs, helping users avoid hidden fees common across ordinary DEXs.Platform Highlight:Chains: Ethereum, Arbitrum, Optimism, Polygon, BNB Chain, AvalancheFees: Zero added fees; aggregator rates passed directly to usersToken Utility: No token; delivers value through routing precision and privacy3. Jupiter ExchangeJupiter Exchange leads swap aggregation on Solana, combining deep liquidity, smart routing, and precision pricing through its proprietary Juno engine. The platform captures nearly all retail trade volume on Solana by optimizing execution paths across AMMs, market makers, and third-party aggregators.Its noteworthy features include gasless swaps, recurring DCA orders, and trigger-based limit orders, all customizable via Ultra or Manual Mode. Jupiter Pro adds advanced analytics and MEV protection, while everyday users benefit from smooth UI and highly competitive pricing.The ecosystem is supported by JUP, its governance token, and JLP, a yield-bearing token minted through liquidity provision. JLP grows in value over time as 75% of platform fees are reinvested directly into the pool, compounding user exposure to Solana-native assets.Platform Highlight:Chains: SolanaFees: 0.1% on volatile pairs; 0% in Manual Mode; fee-free for core pairs like SOL/Stables and JUP/SOLToken Utility: JUP for governance; JLP as a yield-accruing LP token backed by protocol fees4. 1inch1inch is still the go-to DEX aggregator for users seeking the most capital-efficient swaps across Ethereum and major Layer 2s. Its routing engine, Pathfinder, splits trades across multiple DEXs and markets to return superior swap rates compared to any single venue.What makes 1inch exceptional today is Fusion Mode, a gasless, auction-based swapping system. Users can choose between "Fast," "Fair," or "Custom" auction strategies, with front-running protection built in via resolver bundling. Classic Mode remains available for immediate execution with full control and direct gas payment.The platform's token, 1INCH, powers governance, resolver operations, and delegation via Unicorn Power. Stakers can lock tokens for up to two years to earn resolver eligibility or delegate their voting power to earn yield from resolver farming incentives.Platform Highlight:Chains: Ethereum, Arbitrum, Optimism, Polygon, BNB Chain, ZKsync, Base, Avalanche, and more.Fees: No platform fee; users only pay embedded DEX fees or auction spread depending on modeToken Utility: 1INCH is used for DAO governance, staking, resolver participation, and yield delegation5. OpenOceanOpenOcean is the most expansive DEX aggregator in 2025, integrating over 30 blockchains and sourcing liquidity from 1,000+ DEXs. Its reach spans both EVM and non-EVM networks, allowing users to access efficient swaps on Ethereum, Solana, Aptos, Starknet, zkSync, and more, all in one interface.The platform's standout feature is Ultra Mode, which offers gasless, MEV-protected swaps using Uniswap's Permit2 standard. Users can trade without needing native tokens for gas, while benefiting from the lowest swap fees, 0.2% on volatile pairs and 0.04% on stablecoins.OpenOcean also supports professional-grade tools like gasless limit orders, DCA strategies, and deep routing through illiquid tokens. The OOE token powers governance, DAO participation, and staking incentives. OOE stakers unlock monthly gas fee refunds (up to $1,000) and gain influence through the OpenOcean DAO.Platform Highlight:Chains: 30+ including Ethereum, Solana, Arbitrum, Base, Optimism, zkSync, Aptos, StarknetFees: 0.2% on volatile pairs, 0.04% on stablecoins in Ultra Mode; no fees in Advanced modeToken Utility: OOE enables DAO voting, unlocks gas rebates, and powers staking incentives6. VeloraVelora (formerly ParaSwap) aggregates liquidity across hundreds of sources and executes complex swaps through a unified interface or API. It is one of the few platforms that blend AMMs, private market makers, and bridging seamlessly for multi-path, gas-optimized execution, and batch actions.Its standout feature is Velora Delta, an intents-based protocol that enables gasless swaps with front-running protection, thanks to agent-based execution. Orders are routed through competitive auctions, allowing multiple agents to bid on execution, minimizing MEV and improving price outcomes.Velora is governed by the Velora DAO and powered by the PSP token, available across Ethereum, Polygon, BSC, Fantom, and Optimism. PSP holders can stake in two formats (sePSP1, sePSP2), participate in governance, and access fee-sharing rights.Platform Highlight:Chains: Ethereum, Polygon, BSC, Fantom, Optimism, and integrated non-EVM support via bridge pathsFees: No platform fee; optional partner fees (Velora DAO captures 15% of it up to 100% surplus)Token Utility: PSP powers DAO governance, staking (sePSP1/sePSP2), and fee-sharing7. CoW SwapCoW Swap is the primary interface for CoW Protocol, a meta-DEX aggregator built on batch auctions and intent-based execution. Rather than submitting direct on-chain swaps, users sign trade intents that solvers match through auctions, maximizing price efficiency and surplus.This auction model enables unique benefits: trades are MEV-resistant, often matched peer-to-peer, and routed through both AMMs and private liquidity. Solvers compete to deliver the most value, clearing trades at a uniform price and shielding users from frontrunning and slippage.The protocol is governed by CoW DAO, with solvers incentivized in COW tokens. CoW Swap charges no platform fees; solvers monetize by capturing trade surplus. Users also gain access to advanced order types like limit, TWAP, Milkman, and programmable CoW Hooks.Platform Highlight:Chains: Ethereum (core); partner integrations extend across other EVM chainsFees: No swap fees; surplus captured by solvers; MEV Blocker rebates availableToken Utility: COW used for governance and solver incentives in CoW ProtocolWhat is a DEX Aggregator?A DEX aggregator is a protocol that sources liquidity from multiple decentralized exchanges to give users the most favorable trade execution. It automatically evaluates price, slippage, and gas costs across platforms, helping users avoid manual comparisons or suboptimal routes.Here's a breakdown of DEX aggregator types by complexity and scope:Simple DEX (Level 0): A standalone AMM or orderbook DEX sourcing liquidity only from its own pools on a single network. Examples: Uniswap, Trader Joe, Raydium.DEX Aggregator (Level 1): Aggregates prices from multiple DEXs on a single blockchain to offer better execution. Examples: Jupiter, Panora.Multi-Chain DEX Aggregator (Level 2): Routes trades across DEXs on several blockchains using cross-chain contract logic or RPC switching. Examples: OpenOcean, Velora.Meta DEX Aggregator (Level 3): Aggregates data from both DEXs and other aggregators to optimize price and execution. Examples: LlamaSwap.DEX + Bridge Aggregator (Level 4): Combines DEX and cross-chain bridge routing to swap assets across chains in a single transaction. Examples: Rango, Jumper.How DEX Aggregators WorkDEX aggregators operate by scanning multiple decentralized exchanges in real time to identify the most efficient trading route for a given token pair. They account for on-chain variables such as pool depth, slippage, gas fees, and price impact to determine the optimal execution path.When a user submits a trade, the aggregator's routing algorithm splits the order across several liquidity sources if needed, reducing slippage and improving price. Some aggregators also support multi-hop swaps, using intermediary tokens to improve execution, especially when direct pools are illiquid or inefficient.Advanced aggregators may also integrate bridging protocols or intent-based execution layers. These enable cross-chain swaps or solver-based auctions that outsource trade execution to third parties competing to deliver the best price.Are DEX Aggregators Safe?Most leading DEX aggregators are non-custodial and open-source, meaning they do not hold user funds and rely on auditable smart contracts. However, they are not immune to risks, bugs in routing logic, smart contract exploits, or third-party integrations can all expose users to losses.In 2024, ParaSwap's router narrowly avoided a serious exploit, while TransitSwap suffered a $21M hack from flawed routing logic. These incidents show that even well-audited systems can be vulnerable if dependency layers aren't secured.Additionally, some DEX aggregators now enforce front-end restrictions due to regulatory pressure. For example, 1inch applies geo-blocking for users in sanctioned regions, and even IP-masking features like Safari's "Hide IP" can inadvertently trigger access errors for compliant users.DEX Aggregators vs DEXs vs CEXsDEX aggregators are often confused with the very platforms they aggregate or compete with. To understand their unique value, it's helpful to compare them directly to decentralized exchanges (DEXs) and centralized exchanges (CEXs).DEX Aggregators vs DEXsA DEX is a standalone decentralized exchange that allows users to trade assets directly from their wallets, using its own liquidity pools. It executes trades through either automated market makers (AMMs) or orderbooks, depending on the design.In contrast, a DEX aggregator connects to many DEXs at once, scanning them to find the best price, lowest slippage, or most efficient routing. Some aggregators can even split orders across multiple DEXs or use multi-hop paths to improve execution, which single DEXs cannot do alone.DEX Aggregators vs CEXsCEXs are custodial platforms where users deposit funds and trade within the exchange's internal system. While they often offer deep liquidity and high-speed execution, users rely entirely on the platform's solvency, controls, and compliance with local regulations.DEX aggregators, on the other hand, offer CEX-like execution quality without custody risk, as trades are executed on-chain directly from the user's wallet. However, aggregators may lack some CEX features like fiat support, advanced margin tools, or centralized customer service.Final ThoughtsDEX aggregators are the power tools of onchain trading. They route around slippage, scan across chains, and execute swaps with surgical precision. By combining prices from dozens of sources, they let you trade smarter without giving up custody or control.Whether you're bridging assets, farming yield, or chasing that perfect price, an aggregator turns complexity into a single click. So next time you're swapping, ask yourself: why settle for one DEX when you can tap into all of them? Many thanks to Lucas Bruder, Max Resnick, Eugene Chen, Mert Mumtaz, 0xIchigo, Uri Klarman and Nitesh Nath for reviewing earlier versions of this work.Actionable InsightsMEV on Solana operates differently from other blockchain networks due to its distinctive architecture and the lack of a global mempool. Out-of-protocol mempools must be developed independently, requiring adoption by a significant portion of the network's stake to function effectively, which presents a high technical and social barrier.Jito suspended its public mempool in March 2024, incurring a significant revenue loss. This move immediately reduced harmful MEV practices. However, the decision has encouraged the rise of alternative mempools that lack transparency and primarily benefit a select group with exclusive access.Memecoin traders are especially susceptible to sandwich attacks, as they set high slippage tolerances when trading illiquid and highly volatile assets. This user subset favors Telegram trading bots for faster execution and real-time notifications. Memecoin traders are relatively insensitive to the front-running of their trades.Marinade Finance's Stake Auction Marketplace (SAM) employs a competitive auction mechanism in which validators bid directly against one another for stake allocation in a "pay-for-stake" system. The program has faced criticism, as it enables validators engaging in user-sandwiching to outbid others, securing more stake and increasing their influence within the network.Much of Solana's sandwiching originates from a private mempool operated by a single entity, DeezNode. A key validator operated by DeezNode, identified by the address HM5H6 …jdMRA, currently holds 811,604.73 SOL in delegated stake, valued at approximately $168.5 million. This validator experienced a sharp increase in delegated stake, rising from 307.9k SOL on November 13 (epoch 697) to 802.5k SOL by December 9 (epoch 709). Since then, the growth has stabilized. Notably, 19.89% of this stake originates from Marinade's mSOL liquid stake pool and native delegations.Multiple Solana validator operators have publicly reported receiving lucrative offers to participate in private mempools, including detailed documents outlining profit shares and projected earnings.Jito bundles are the primary method searchers use to ensure profitable transaction ordering. However, Jito data does not capture the full scope of MEV activity; in particular, it does not capture profits from searchers or activity happening through alternative mempools. Furthermore, many applications utilize Jito for non-MEV purposes, bypassing priority fees to ensure timely transaction inclusion.Over the past year, more than 3 billion Jito bundles were processed, generating 3.75 million SOL in total tips. This activity exhibited a clear upward trend, from a low of 781 SOL in tips on January 11th to a high of 60,801 SOL on November 19th.Jito's arbitrage detection algorithm, which analyzes all Solana transactions, including those outside Jito bundles, identified 90,445,905 successful arbitrage transactions over the past year. The average profit per arbitrage was $1.58, with the most profitable single arbitrage yielding $3.7 million. These arbitrages generated $142.8 million in profits, of which $126.7 million (88.7%) were denominated in SOL.The DeezNode mempool operates a sandwich bot at address vpeNAL..oax38b. Internal analysis from Jito indicates that nearly half of all sandwich attacks on Solana can be attributed to this single program. Over 30 days (Dec 7th to Jan 5th), the program executed 1.55 million sandwich transactions for a profit of 65,880 SOL ($13.43 million). The average profitability per attack was 0.0425 SOL ($8.67). Annualizing this data, the program would generate a yearly profit of 801,540 SOL. In a worst-case scenario for network centralization, where 100% of profits are reinvested, their share of the network stake would increase by 0.2%.This bot is just one of many on-chain programs executing sandwich attacks. To view detected sandwich attacks on Solana in real time, visit sandwiched.me.Validator whitelists are widely seen as a last resort in combating bad actors. They risk creating a semi-permissioned and censored environment that directly conflicts with the industry's decentralized ethos. In some cases, this approach could also delay transaction processing, creating a suboptimal user experience.Sandwich-resistant AMMs are experimental designs that build upon traditional constant-product AMMs. With sr-AMMs, no swaps are executed at a price more favorable than the pool's price at the start of the slot window. This mechanism effectively neutralizes the profitability of sandwich attacks. Ellipsis Labs published Plasma, an audited reference implementation of a sandwich-resistant AMM design.Multiple Concurrent Leaders (MCL) offer a promising long-term solution for mitigating harmful MEV by allowing users to choose between leaders without incurring delays. If Leader A acts maliciously, users can redirect their transactions to an honest Leader B. However, implementing MCL is expected to take several years of development.IntroductionMaximal Extractable Value (MEV) is the value that can be extracted by manipulating transaction sequencing. This includes adding, removing, or reordering transactions within a block. MEV manifests in various forms, but all share a common factor: they hinge on transaction ordering. Searchers—traders who monitor on-chain activity—attempt to place their trades strategically before or after other transactions to extract value.On Solana, MEV functions differently from other blockchain networks, primarily due to its unique architecture and the absence of a global mempool. Features such as Turbine, which propagates state updates, and Stake-Weighted Quality of Service (SWQoS) for transaction forwarding shape its approach to MEV. Solana's fast streaming block production, without relying on external add-ons or out-of-protocol auction mechanisms, narrows the scope for conventional approaches to certain types of MEV, such as front-running. To gain an edge, searchers operate their own nodes or collaborate with high-staked validators to access the most current blockchain state.MEV has become an overloaded term, with differing opinions on its precise definition. Contrary to popular belief, not all MEV is bad. Due to blockchains' distributed and transparent nature, full elimination of MEV is widely considered unlikely. Networks that claim to have eradicated MEV either lack sufficient user activity to attract searchers or employ techniques such as randomized block packing, which, while seemingly mitigating MEV, can incentivize spam.Sandwiching is the form of MEV that attracts the most attention and is detrimental to users. In this strategy, a searcher places one transaction before and another after a target transaction to extract value. While profitable for searchers, sandwiching increases transaction costs and worsens execution prices for regular users. A detailed discussion of sandwiching will be provided in a later section.A visualization of a typical sandwich attack. An attacker front-runs and then back-runs the victim's buy transaction for profit.With this report, we will analyze Solana's current MEV landscape. It is organized into four sections:Solana MEV Timeline: Outlines a chronological series of key events, offering valuable context for readers less familiar with the rapid evolution of MEV on Solana.Forms of MEV: Explores the various forms of MEV observed on Solana today, supported by concrete and detailed examples.Solana MEV Data: This section presents relevant, quantifiable, and contextual data to illustrate the current scope and impact of MEV in Solana.MEV Mitigation Mechanisms: Examines the strategies and mechanisms being considered to reduce or eliminate harmful forms of MEV.While these sections are best read sequentially, each can be consumed independently.Solana MEV TimelineBelow is a timeline of important events related to Solana's MEV landscape.September 2021 to April 2022 - Spam and DDoS AttacksNFTs were the first sector to gain significant traction on Solana. MEV in the NFT space primarily arises during public minting events, where participants compete to secure rare or valuable assets. These events create sudden and extreme opportunities for searchers, with no MEV potential in the block preceding a mint and substantial MEV potential in the block immediately after. NFT minting mechanics were among the earliest causes of large-scale congestion spikes on Solana caused by spam transactions from bots overwhelming the network and leading to temporary halts in block production.Mid 2022 - The Introduction of Priority FeesSolana implemented an optional priority fee that users can specify within the compute budget instruction to prioritize their transactions. This mechanism helped mitigate network congestion by enabling users to pay for expedited processing during periods of high activity. It also established a more efficient framework for fee markets, enhancing the network's economic model.Priority fees help discourage spam by shifting the competitive landscape. Bots that previously relied on brute-force transaction volume to gain an advantage can no longer dominate solely through spamming. Instead, prioritization is also determined by the fees users are willing to pay.August 2022 - The Jito-Solana Client is LaunchedJito has become the default Solana MEV infrastructure. The client is designed to democratize MEV capture, ensuring a more equitable distribution of rewards across the network. When leaders use the Jito client validator, their transactions are initially directed to the Jito-Relayer, which functions as a transaction proxy router. This relayer holds transactions for 200 milliseconds before forwarding them to the leader. This speed bump delays incoming transaction messages, providing a window for off-chain auctions via the Jito Block Engine. Searchers and applications submit bundles of atomically executed transactions together with a tip dominated in SOL. Jito charges a 5% fee on all tips, with a minimum tip of 10,000 lamports. Bundles can be examined through the Jito bundle explorer. The current Jito architecture comprises a block engine that accepts bundles from searchers and a relayer that delays incoming transactions to the leaderThis approach reduces spam and enhances the efficiency of Solana's computing resources by running the auctions off-chain and posting only the single winner into the block. This is important, considering unsuccessful transactions consume a significant portion of the network's computing resources.For its first nine months, the Jito-Solana client's adoption remained under 10% as network activity remained low and MEV rewards were minimal. Starting in late 2023, adoption accelerated significantly, reaching 50% by January 2024. Today, over 92% of Solana's validators, weighted by stake, use the Jito-Solana client. January 2024: The Onset of Memecoin SeasonIn early 2024, network activity surged. Memecoins such as Bonk and DogWifHat gained traction, sparking heightened interest among searchers and significantly increasing MEV activity. This period marked a notable shift in user behavior: memecoin traders favor Telegram trading bots such as BonkBot, Trojan, and Photon over traditional decentralized exchanges or aggregators. These bots offer superior speed, real-time notifications, and an intuitive, text-based interface that appeals to retail speculators. Known for setting high slippage rates to prioritize time-sensitive trades, these traders are relatively insensitive to their trades being front-run.March 2024: Jito Suspends Their Flagship Mempool FeatureJito's mempool provided searchers a 200-ms window to preview all incoming transactions to the leader. During its operation, this system was frequently used for sandwich attacks, significantly degrading user experience. To prioritize the network's long-term growth and stability, Jito made the contentious decision to suspend its mempool, sacrificing significant revenue in the process. While the move garnered widespread support, it faced criticism from a few prominent figures, including Mert Mumtaz and Jon Charbonneau.The primary risk of this decision was the potential emergence of alternative mempools replicating Jito's functionality, enabling the extraction of more harmful forms of MEV. Unlike public mempools, which promote a fairer distribution of MEV opportunities and mitigate power imbalances across the network, private permissioned mempools operate without transparency and benefit only the select few with access to them.Multiple Solana validator operators have reported receiving lucrative offers to participate in private mempools.May 2024: A New Transaction SchedulerAs part of the Agave-Solana 1.18 update, a new scheduler significantly improved Solana's ability to order transactions deterministically. The improved scheduler better prioritizes transactions with higher fees, increasing their likelihood of block inclusion. The central scheduler constructs a dependency graph, known as a "prio-graph," to optimize the processing and prioritization of conflicting transactions across multiple threads.Previously, bots engaged in arbitrage and other MEV activities were incentivized to flood the leader with spam to improve their chances of successful execution. The stochastic nature of the old scheduler introduced jitter, causing variability in transaction placement within a block. The new deterministic approach reduces this randomness, discouraging spam and improving the network's overall efficiency.June 2024: Marinade Launches Stake Auction Marketplace (SAM)Marinade Finance's Stake Auction Marketplace (SAM) employs a competitive price auction mechanism where validators bid directly against one another for stake allocation in a "pay-for-stake" system. This structure incentivizes validators to bid up to the maximum rate they deem profitable. The program has faced criticism, as it enables validators engaging in user-sandwiching to outbid others, securing more stake and increasing their influence within the network. Marinade Labs has recently proposed establishing a public committee for delegation oversight. Marinade Finance's mSOL is Solana's second-largest liquid staking token and stake pool after Jito.As of epoch 717, validators with 0% staking commission and 0% MEV commission typically offer stakers an APY of around 9.4%. Validators utilizing out-of-protocol methods to redistribute block rewards generally provide an APY of 10% or less. In contrast, Marinade's SAM auction shows a winning APY of 13.73%, with the top ten validator bids reaching 18.27% APY.This disparity suggests that these validators are either bidding irrationally and incurring losses, subsidizing their bids with stake delegations from the Solana Foundation, or supplementing their income through alternative sources, such as MEV extracted from sandwiching users.December 2024: Increased Concerns Over New Private MempoolsSolana MEV became a contentious topic after Solana-focused research firm Temporal publicly raised concerns about the potential centralization of network stake. This sparked widespread debate and reignited efforts to address Solana's MEV challenges. Validators engaging in harmful MEV extraction capture disproportionate value, leading to their stake growing faster than others. This enables the validator to accumulate greater network influence over time, introducing centralization risks to Solana's validator economy. Validators with higher earnings can offer increased returns to stakers, drawing in more stake and further consolidating their position.Much of Solana's sandwiching originates from a private mempool operated by a single entity, DeezNode. A key validator operated by DeezNode, identified by the address HM5H6 …jdMRA, currently holds 811,604.73 SOL in delegated stake, valued at approximately $168.5 million. This validator experienced a sharp increase in delegated stake, rising from 307.9k SOL on November 13 (epoch 697) to 802.5k SOL by December 9 (epoch 709). Since then, the growth has stabilized. Notably, 19.89% of this stake originates from Marinade's mSOL Liquid Stake Pool and Marinade native delegations. Representing 0.2% of the total stake (currently 392.5 million SOL), the validator is ranked 93rd by stake among the broader validator set and lies outside the supermajority subset.Jito's internal analysis reveals a growing number of sandwich attacks occurring outside of Jito's auction mechanism, indicating the presence of additional block engines or modified validator clients engaging in sandwiching activities.Forms of MEVLet's examine the various types of MEV on Solana, illustrating each with concrete examples of real transactions. Below are the most prevalent MEV transaction types observed on Solana today.LiquidationsWhen borrowers fail to maintain the required collateralization ratio for their loans on lending protocols, their positions become eligible for liquidation. Searchers monitor the blockchain for these undercollateralized positions and execute liquidations by repaying part or all of the debt in exchange for a portion of the collateral as a reward. Liquidations are considered a form of good MEV. They are essential for maintaining protocol solvency and contribute to the stability of the broader on-chain defi ecosystem.Example Liquidation TransactionThis liquation occurred on December 10 via Kamino, Solana's largest lending protocol by liquidity and user base. The transaction involved three steps:The searcher initiated the liquidation by transferring 10.642 USDC to the Kamino Reserve to cover a user's debt position.In exchange, the Kamino Reserve transferred the user's collateral of 0.05479 SOL to the searcher.The searcher paid a protocol fee of 0.0013 SOL.Additionally, the searcher paid a priority fee of 0.001317 SOL for the transaction, resulting in a net profit of 0.0492 USD.An example liquidation transaction on Solana's Kamino money marketArbitragesArbitrage enhances market efficiency by aligning prices across different venues, capitalizing on price discrepancies for the same asset. These opportunities can occur intra-chain, cross-chain, or between centralized and decentralized exchanges (CEX/DEX arbitrage). Among these, intra-chain arbitrage guarantees atomicity, as both legs of the trade can be executed together in a single Solana transaction. In contrast, inter-chain and cross-platform arbitrage introduce additional trust assumptions.Atomic arbitrage is the dominant form of MEV on Solana. The simplest example of atomic arbitrage arises when two DEXs list different prices for the same trading pair. This typically involves exploiting stale quotes on a constant product (xy=k) automated market maker (AMM) and offsetting the trade on an on-chain limit order book, where market makers have already adjusted their quotes to reflect off-chain price movements.Example Arbitrage TransactionIn this scenario, the price of the SOL/USDC pair has shifted off-chain, prompting a Phoenix market maker to update their quotes accordingly. Meanwhile, the Orca AMM continues to quote based on a stale price, creating an arbitrage opportunity for a searcher. The searcher purchases 2.11513 SOL with 45 USDC on Orca and then sells 2.115 SOL for 45.0045 USDC on Phoenix, earning a profit of 0.00013 SOL (approximately $0.026). Arbitrage transactions are executed atomically, eliminating the need for searchers to hold inventory. The primary risk lies in fees paid for reverted transaction attempts.Front-runningFront-running refers to an MEV searcher identifying another trader's buy or sell order in the mempool and placing an identical order before the trader, profiting from the price impact of the victim's transaction.It occurs when an observer notices an unconfirmed transaction that will likely impact the price of a token and acts on this information before the original transaction is processed. This front-running strategy is straightforward and does not involve the complexities of other methods, such as sandwich attacks.A searcher becomes aware of a pending buy transaction that will positively impact the target token price. The searcher bundles their buy transaction with the target transaction. Their order will be processed at a lower price before the target, and they will profit once the target's transaction has been finalized. In the process, the target suffers a loss as they buy at a higher price due to the impact of the MEV searcher's buy transaction.Back-runningBack-running is the counterpart to front-running and a specific MEV strategy that exploits temporary price imbalances created by another transaction, often caused by poor routing. Once a user's transaction is executed, back-running searchers equalize prices across pools by trading the same asset and securing a profit. Theoretically, the user could have captured this profit through more efficient trade execution.Example Backrun TransactionThis famous back-run occurred on January 10, 2024, when a user bought 8.9 million dollars worth of DogWifHat (WIF) in a single transaction. At the time, the WIF token traded at 0.2 dollars and had only a few million dollars worth of liquidity across all on-chain venues. The Jupiter aggregator executed this transaction across the limited liquidity available in three pools, resulting in a price wick that reached $3.The searcher executed the back-run using a Jito Bundle, offering a substantial Jito tip of 890.42 SOL ($91,621). They first exchanged 703.31 SOL ($72,368) for 490,143.90 WIF tokens via a Raydium concentrated liquidity pool. Next, they traded these WIF tokens for 19,035.97 SOL ($1,958,733) through a Raydium V4 liquidity pool. This sequence yielded a net profit of 17,442.24 SOL ($1,794,746) in a single transaction. All dollar values reflect the prices at the time of the transaction.Sandwich AttacksSandwich attacks are the most notorious form of toxic MEV. They exploit traders who place orders on AMMs or bonding curves with high slippage tolerances. Traders set high slippage not to accept worse prices but to ensure fast order execution. Memecoin traders (looking for those 100x gems) are particularly vulnerable to sandwich attacks because they tend to set high slippage tolerances when trading in illiquid, highly volatile assets. Sandwiching imposes a strict negative externality on the end trader—this user gets filled at the worst possible price.A typical sandwich attack involves three transactions atomically bundled together. First, the attacker executes an unprofitable front-run transaction, buying the asset to drive its price to the worst execution level allowed by the victim's slippage settings. Next, the victim's transaction occurs, increasing the price further as it executes at this unfavorable level. Finally, the attacker completes a profitable backrun transaction, selling the asset at the inflated price, offsetting their initial loss, and securing a net profit.Example Sandwich Attack TransactionThis attack happened on December 16th, 2024, through a well-known Sandwich attack program (vpeNALD… Noax38b). A searcher submitted these transactions as an atomic Jito bundle, paying a tip of 0.000148 SOL ($0.03).An example sandwich attack bundling three transactions togetherCharacteristics indicating this was a sandwich attack:The signer of the middle transaction is different from the first and last transactions.The token bought in the first two transactions is the same token sold in the third transaction.The token traded was a newly minted illiquid and highly volatile Pump Fun token.The searcher made a net profit of 0.01678 SOL, roughly $3.35 at the time of the transaction.Solana MEV Data This section evaluates the current Solana MEV landscape through available public data. We begin by examining Jito's performance metrics, followed by insights into the number of reverted transactions and a breakdown of arbitrage profitability. The section concludes with a case study detailing the behavior and profitability of a prominent sandwich bot.JitoJito bundles are the primary method searchers use to ensure profitable transaction ordering. Most Jito tips come from the demand for the top of the block from users who want to be the first to buy a token or capture an opportunity. However, Jito data does not capture the full scope of MEV activity; in particular, it does not capture profits from searchers or activity happening through alternative mempools. Furthermore, many applications utilize Jito for non-MEV purposes, bypassing priority fees to ensure timely transaction

inclusion.Data from transfers to eight designated Jito tip accounts reveal that, over the past year, more than 3 billion bundles were processed, generating 3.75 million SOL in total tips. This activity exhibited a clear upward trend, from a low of 781 SOL in tips on January 11th to highs of 60,801 SOL and 60,636 SOL on November 19th and 20th, respectively. A notable slowdown occurred during Q3, with tips dropping to a low of 1,661 SOL on September 7th. Tips values before December 2023 were negligible compared to the substantial growth seen throughout 2024.The daily amount of Jito tips in SOL (Data source: Dune Analytics, 21co)The volume of bundles processed through Jito has grown consistently throughout 2024, culminating in a peak of 24.4 million bundles on December 21st. This growth included two significant surges. The first occurred between May and early July, with daily bundles increasing fourfold from approximately 3 million to 12 million, likely in response to issues with network congestion. The second surge occurred from November to December, as daily bundle volume doubled from around 12 million to a peak of 24 million.The number of accounts using Jito has shown a parallel upward trajectory, beginning the year with approximately 20,000 daily tippers and peaking at nearly 938,000 on December 10th. Significant growth periods include an increase from 21,000 in early March to 135,000 by mid-April (a 6x increase) and another sharp rise from 208,000 in October to 703,000 by the end of the month (a 3.4x increase). The daily number of Jito tippers (Data source: Dune Analytics, Andrew Hong)The adoption of the Jito-Solana client among validators grew steadily throughout 2024, enhancing the effectiveness of Jito bundles for fast transaction inclusion. At the start of the year, validators using the Jito-Solana client represented 189.5 million staked SOL, accounting for 48% of the total network stake. By the beginning of 2025, this figure had risen to 373.8 million staked SOL, 92% of the total stake.Reverted TransactionsA substantial portion of transactions on Solana are attributable to spam associated with MEV extraction. By examining the ratio of reverted to successful transactions, we can identify patterns indicative of MEV bots competing to capture arbitrage opportunities.Spamming presents a significant challenge as it results in many reverted transactions. In the winner-takes-all nature of MEV, only one transaction can exploit a given opportunity. However, even after this opportunity is captured, leaders often process other transactions attempting to exploit the same opportunity. These reverted transactions still consume valuable compute resources and network bandwidth. The competitive latency race among searchers further exacerbates the issue, flooding the network with duplicate transactions and, in extreme cases, causing congestion and a degraded user experience. Due to Solana's low transaction costs, reverted arbitrage spam retains a positive expected value. Over time, traders can achieve profitability by executing these trades at scale despite individual failures.Reverted transactions peaked in April 2024, accounting for 75.7% of all non-vote transactions. This percentage dropped significantly following the rollout of key updates, including the Agave 1.18 central scheduler. The new scheduler improved deterministic transaction ordering within the banking stage, curbing the effectiveness of spam.Arbitrage ProfitabilityJito's arbitrage detection algorithm, which analyzes all Solana transactions, including those outside Jito bundles, identified 90,445,905 successful arbitrage transactions over the past year. The average profit per arbitrage was $1.58, with the most profitable single arbitrage yielding $3.7 million. These arbitrages generated $142.8 million in profits, of which $126.7 million (88.7%) were denominated in SOL.Arbitrage transaction profits by token for 2024 (Data source: Jito)Case Study: Vpe Sandwich ProgramDeezNode operates an on-chain sandwich bot at the address vpeNAL..oax38b as part of their alternative mempool operations. This highly active program has recently gained notoriety for executing large-scale user sandwich attacks.Internal analysis from Jito indicates that nearly half of all sandwich attacks on Solana can be attributed to this single program.The Vpe program is the source of just under half of all Solana sandwich attacks (Source: Jito internal)Over one 30-day period (Dec 7th to Jan 5th), the program executed 1.55 million sandwich transactions, averaging approximately 51,600 daily transactions, with a success rate of 88.9%. The program generated a profit of 65,880 SOL ($13.43 million), equating to roughly 2,200 SOL per day. Jito tips paid by the program totaled 22,760 SOL ($4.63 million), averaging around 758 SOL daily. The average profitability of a sandwich transaction was 0.0425 SOL ($8.67).The Vpe sandwich bot's extracted value from Dec 7th, 2024, to Jan 5th, 2025.The majority of victim transactions involved swaps conducted through Raydium. Among the top 20 sandwiched tokens, 16 were created on Pump Fun, identifiable by vanity token mint addresses ending in 'pump.'The Vpe sandwich bot is one of many on-chain programs that execute sandwich attacks. Visit sandwiched.me for a real-time view of detected sandwich attacks on Solana.Annualizing the profit data from December, this program is projected to generate a yearly profit of 801,540 SOL. In a worst-case scenario for network centralization, where 100% of these profits are reinvested into the alternative mempool's validators, their share of the network stake would increase by 0.2%, assuming the overall network stake remains unchanged.This worst-case scenario is unlikely for several reasons. First, the network is currently experiencing near-record activity levels. Second, it is reasonable to assume that pool searchers and operators would cash out a portion of their profits rather than reinvest all gains.MEV Mitigation MechanismsSubstantial resources have been dedicated to studying and exploring various mechanisms for mitigating or reallocating MEV. General-purpose, out-of-protocol solutions are increasingly integrated into applications and infrastructure to minimize the on-chain MEV surface area. These mechanisms include:Validator WhitelistsOne proposed idea is that stakers, RPC providers, and other validators could socially ostracize validators caught sandwiching by ignoring their leadership slots. However, whitelists are widely seen as a measure of last resort. Since leaders are assigned four consecutive slots, this approach could delay transaction processing for several seconds, a suboptimal user experience. More critically, whitelists risk creating a semi-permissioned and censored environment that directly conflicts with the decentralized ethos of the blockchain industry. Additionally, such systems carry the inherent risk of mistakenly excluding honest validators, potentially undermining network trust and participation.As an aside, independent developers and applications can freely establish their own validator allow or deny lists, a feature supported by the sendTransaction method in the Helius Node.js SDK.Dynamic Slippage + MEV ProtectionManaging slippage has traditionally been a challenging and tedious process for users, requiring manual adjustments tailored to their trading tokens. This approach is particularly burdensome when handling volatile or illiquid tokens, as the slippage settings suitable for stable assets such as liquid staking tokens or stablecoins differ significantly from those required for memecoins.In August 2024, Solana's most popular retail trading platform, Jupiter Aggregator, introduced dynamic slippage to address this complexity. This algorithmic mechanism optimizes slippage settings in real time, leveraging a set of heuristics to calculate the ideal slippage threshold for each trade. These heuristics consider factors such as:Current market conditionsThe types of tokens being traded (e.g., stable pairs versus volatile memecoins)The pools or order books the trade is being routed throughThe user's maximum slippage toleranceThe heuristics ensure the trade is optimized for success with the least slippage, reducing the scope for MEV extraction.MEV Protect Mode is an increasingly common feature across decentralized exchanges and Telegram trading bots. When enabled, user transactions are routed exclusively to Jito block engines, significantly reducing the risk of sandwich attacks. However, this protection comes at the cost of slightly higher transaction fees. Anecdotal evidence suggests that many Telegram bot users do not enable MEV protection even when offered. Their primary concern is fast transaction inclusion, and they prioritize speed over reducing the risk of sandwich attacks.RFQ systemsRFQ systems are gaining traction on Solana, enabling orders to be fulfilled by professional market makers instead of on-chain AMMs or order books. These systems use signature-based pricing, allowing for off-chain computation, with price discovery happening off-chain and only the final transaction recorded on-chain. Examples include:Kamino Swapan intents-based exchange platform designed to eliminate slippage and MEV. Kamino leverages the Pyth Express Relay to broadcast swap requests to a network of searchers, who compete in an auction to fill the transaction. The winning searcher provides the best execution price and pays a tip to the user. In cases where arbitrage opportunities arise, searchers may execute trades at even better prices than requested, generating a trade "surplus." Users benefit by retaining any surplus from their transactions, enhancing their overall execution value.JupiterZ (Jupiter RFQ)Starting in December, JupiterZ was enabled by default for all swaps on Jupiter. This feature allows swaps to automatically select the best price between Jupiter's standard on-chain routing engine and its RFQ system. With RFQ, users benefit from no slippage or MEV, as trades are executed directly with off-chain market makers. Additionally, market makers cover the transaction priority fee, and transactions are CU-efficient, bypassing the need for complex routing logic.RFQ systems excel with widely traded tokens listed on CEXs. However, they are less effective for newer, low-liquidity, and highly volatile on-chain assets. Unfortunately, these are precisely the trades most susceptible to MEV exploitation. An additional downside is that liquidity moves off-chain, reducing composability.Sandwich Resistant AMMsSandwich-resistant AMMs (sr-AMMs) are experimental designs that build upon traditional constant-product (xy=k) AMMs. With sr-AMMs, no swaps are executed at a price more favorable than the pool's price at the start of the slot window. This mechanism effectively neutralizes the profitability of sandwich attacks.sr-AMMs function using slot windows to manage trades. Swaps within a slot window affect the pool asymmetrically for buy and sell orders:When a buy order is executed, the offer price on the pool increases along the xy=k curve while the bid price remains unchanged, effectively adding liquidity to the bid side. Conversely, sell orders deplete this bid-side liquidity, reducing the offer price as determined by the xy=k curve.At the start of each new slot window, the sr-AMM resets to its equivalent xy=k state, recalibrating the bid and offer prices. By decoupling these resets from individual transactions and maintaining consistent pricing within each slot window, sr-AMMs disrupt the atomic execution required for profitable sandwich attacks, rendering them ineffective.Sandwiching remains possible at the boundaries between slots. If a leader controls consecutive slot windows, they can execute a front-run and the target transaction at the end of the first slot, followed by a back-run at the start of the following slot.Ellipsis Labs published Plasma, an audited reference implementation of a sandwich-resistant AMM design, this November.Conditional Liquidity & Orderflow SegmentationDecentralized exchanges (DEXs) currently lack mechanisms for applying variable pricing tailored to different types of market participants. This limitation arises because DEXs cannot accurately identify the cost imposed on the DEX protocol by the order flow. DEXs tighten their spreads to attract order flow, inadvertently increasing their exposure to adverse selection from sophisticated takers.Conditional Liquidity introduces a novel mechanism that enables DEXs to dynamically adjust spreads based on the expected toxicity of incoming order flow. This allows DEXs to express a broader range of on-chain, just-in-time preferences. Rather than offering a single spread to all participants, conditional liquidity enables DEXs to present a gradient of spreads calibrated to the perceived likelihood of adverse selection by specific takers.This process relies on a new class of market participants known as Segmenters. Segmenters specialize in assessing the toxicity of order flow and adjust spreads accordingly. They capture a portion of the adjusted spread as compensation while passing the remainder to the wallet or trader. By managing spread-setting responsibilities, Segmenters enable DEXs to better compete for non-toxic order flow. Segmenters compete against one another to minimize adverse selection risks for liquidity providers. The tightest quotes are reserved for flows deemed least likely to harm liquidity providers. In its simplest form, a wallet or application can act as a Segmenter for its own order flow. Alternatively, it could delegate this responsibility of flow segmentation to a marketplace.Orderflow segmentation diagram (Source: DFlow)Users take advantage of this through 'declarative swaps,' which enable them to declare their intent to swap and leverage a Segmenter for execution. These swaps interact with both existing Solana liquidity sources and conditional liquidity-enabled DEXs. Built with Jito bundles, declarative swaps offer traders a guaranteed quote at the time of signature while recalculating the optimal route just before the transaction lands on the network—ensuring adherence to the initial quote.This approach significantly reduces the latency between route calculation and transaction finalization, mitigating slippage. Moreover, declarative swaps minimize the likelihood of sandwich attacks when routing through conditional liquidity DEXs. By offering tighter spreads to non-toxic flows, these DEXs improve trading conditions for Solana users. Declarative swaps thus provide traders with reduced slippage, lower latency, and enhanced protection against sandwiching, delivering a more efficient and secure trading experience.PaladinPaladin-Solana, a modified version of the Jito-Solana validator client that introduces a minimal code patch (~2k lines) to include Paladin Priority Port (P3) transactions during the bundle stage. The Paladin Priority Port (P3) facilitates high-priority fee transactions. Validators open this express lane as leaders, enabling them to process valuable transactions promptly. Each P3 transaction meets a minimum fee threshold (10 lamports per CU) and is passed directly to the bundle stage for processing in the order received.Paladin prioritizes high-priority fee transactions and actively identifies and drops sandwich bundles based on their transaction patterns. While this might initially seem detrimental to validator rewards, Paladin validators are compensated through trust-based mechanisms. Validators that avoid sandwiching can attract direct transactions, creating an ecosystem of trust and improved earnings.Validators are incentivized by the prospect of earning additional rewards and the trust of users who rely on the P3 express lane. However, if they include sandwich bundles in their blocks, they risk losing P3 transaction revenue. This trust is collateralized with PAL tokens.The PAL token aims to align the interests of validators, users, and the broader Solana community. It has a fixed supply of one billion tokens, 65% of which will be distributed among validators and stakers, and the rest will be split between Solana builders, the Paladin team, and a development fund. Validators can lock PAL to enable P3 transactions on their nodes, creating a decentralized, permissionless, and token-gated mechanism for MEV extraction and transaction prioritization.The project is in its early days and has yet to reach a critical mass of adoption. Currently, 80 validators run Paladin, representing 6% of the network's stake. Paladin claims to increase block reward by 12.5%.Multiple Concurrent LeadersBlock producers maintain a monopoly over transaction inclusion within their assigned slots. Even if the current leader is known to maliciously sandwich transactions, users are unaware and submit their transactions, expecting them to be processed without delay. This lack of optionality over which node processes and orders transactions leaves the user vulnerable to manipulation.A multiple concurrent leaders (MCL) system introduces competition between block producers within the same slot. Users gain the ability to choose between leaders without introducing delays. If Leader A is malicious and known to engage in sandwiching, users or applications could opt to submit their transaction to Leader B, who behaves honestly.Long-term maximizing competition among leaders involves reducing slot durations, limiting the number of consecutive slots assigned to a single leader, and increasing the number of concurrent leaders per slot. By scheduling more leaders per second, users gain greater flexibility, enabling them to choose the most favorable offer from the available leaders for transaction inclusion. Although MCL presents a compelling long-term solution to mitigate MEV, its implementation is complex and will likely require several years of development.Asynchronous Execution (AE) presents another potential approach to reducing MEV. Under AE, blocks are constructed without execution or assessing the results of each transaction. This speed poses significant challenges for algorithms in calculating profitable opportunities and executing effective sandwich strategies on time.ConclusionSolana's MEV landscape is evolving rapidly and remains far from reaching a stable competitive equilibrium. Searchers continue to develop more sophisticated strategies to extract value while the ecosystem adopts a multipronged approach of infrastructure and mechanisms designed to mitigate harmful MEV. Forward-looking ecosystem investors such as Multicoin Capital are allocating capital, believing that value capture from Solana MEV by ecosystem teams will grow significantly and that the distribution of this value capture will look very different in the coming years.Value capture distribution of MEV (Source: Multicoin Capital, Tushar Jain)MEV is an inevitable challenge for any decentralized blockchain with significant financial activity. Confronting and managing this "MEV demon" is essential to the network's long-term success. Having emerged stronger from the difficulties of 2023, Solana now thrives as a blockchain with high activity and growing adoption. However, new challenges lie ahead. To achieve the next level of adoption, the ecosystem must meet these challenges head-on. This is a critical moment in Solana's journey and a pivotal opportunity to define its future.Further Resources SYNTHR utilizes omnichain synthetic assets to power a zero-slippage execution environment. The protocol brings together a combination of pull and push oracles, a zero-slippage omnichain liquidity layer, and multiple independent consensus layers, providing you with a unique cross-chain solution.Omnichain global debt poolThe omnichain global debt pool aggregates cross-chain collateral and debt balances, allowing you to add high-quality liquid collateral on multiple chains and mint omnichain syASSETS on any chain. This enables the creation of overcollateralized debt positions with decentralized cross-chain solvency. The omnichain global debt pool acts as the counterparty for all zero-slippage cross-chain swaps.The architecture consists of multiple light chains and a main chain. The main chain exclusively hosts the aggregator contracts, enabling gas-optimized cross-chain synchronicity. This eliminates the need for any off-chain computations to save gas fees and ensures a censorship-resistant framework.The hedge pool issues hedge pool tokens and swaps its deposits for the current composition of the omnichain global debt pool, ensuring delta neutrality. It rebalances these hedge pool tokens to capture the evolving composition of the omnichain global debt pool. This enables you to generate delta-neutral yield from protocol liquidations and protects you from any sharp second-party debt balance volatility.Every time you mint omnichain syASSETS, you generate personal and protocol debt. The omnichain global debt pool, which represents overall protocol debt, works on the model of debt load sharing. This means that all users are collectively responsible for the protocol's solvency. Your SYNTHR debt shares correspond to your ownership of the omnichain global debt pool.Omnichain syASSETS enable you to seamlessly move between chains without conventional bridges. The zero-slippage omnichain liquidity layer utilizes a combination of pull and push oracles to burn and mint omnichain syASSETS across chains, enabling zero-slippage cross-chain swaps. The combination of oracles ensures price feed accuracy and reliability, while the swaps generate protocol revenue.The GMP aggregator utilizes multiple independent consensus layers to validate cross-chain messages, ensuring democratic and trustless cross-chain finality. This creates an operational barrier between the core contracts and relayers, preventing collusion between the two.The liquidation engine liquidates undercollateralized users, preserving protocol solvency and health. It burns the SYNTHR debt shares of liquidated users and redistributes their collateral and debt balances among remaining SYNTHR debt shareholders. This requires the liquidation engine to carry out cross-chain collateral liquidations and swap them for the protocol's native token before distribution.Build DeFAI agents with cross-chain intelligence.Build omnichain DeFi flywheels with supercharged yield.Build low-slippage DEX aggregators powered by omnichain syASSETS.Mint and trade synthetic alts, BTC, RWAs, and stables with zero slippage.Utilize omnichain syASSETS to borrow other assets and trade perps.Utilize omnichain syASSETS to create and farm exotic DEX pairs.Time-lock syUSD to create vesyUSD. This particular vote-escrow model protects you from any value decay at the end of your time lock and provides you with protocol governance privileges, plus bonus airdrops from ecosystem protocols and early access to ecosystem private sales.Farm LP tokens to earn farming rewards.The liquidation engine distributes liquidation rewards.Mint omnichain syASSETS to earn minting rewards.Create vesyUSD to earn vesyUSD rewards.The protocol distributes all of its revenue to its stakeholders based on their contributions, actively fostering a strong sense of community and propagating continued engagement and collaboration among its participants. It also creates a sense of collective long-term alignment.Buyback and burn: 10%Minting rewards: 60%Protocol operations: 10%vesyUSD rewards: 20%All zero-slippage swaps directly contribute to protocol revenue.SDKs enable one-click deployments of synthetic asset protocols with custom configurations. 30% of revenues from all SDK deployments flow into SYNTHR, which are either distributed to stakeholders or utilized towards buying back and burning the protocol's native token.The GMP and oracle aggregators ensure high levels of transaction security and mitigate front-running risks. Comprehensive insurance, periodic bug bounty programs, regular external audits by third-party firms, and rigorous internal audits intensify overall protocol security. Status quo:Transaction reordering MEV is bad. MEV from censorship or arbitrary inclusion is equally bad. If the dYdX Chain can't prevent both kinds, the playing field could be tilted in a way that harms liquidity and price formation. Solution:Use Cosmos's ABCI++ vote extensions for collaborative block building and introduce frequent batch auctions (FBA) to neutralize transaction sequence effects. Process:Validators vote on order inclusion before a block is produced, the block proposer runs an auction with majority-backed orders, and validators verify the results, which are deterministic, unlike proposer-led block building. Benefits:Proposers can't unilaterally control inclusion (no inclusion MEV), order sequencing doesn't matter (no reordering MEV), and proposer colocation is less valuable (the latency race is more fair). Positive externalities of high-frequency maker-taker competition manifest through price improvement, not value leaked to proposers.The initial version of the dYdX Chain employs a social mitigation strategy to curb maximal extractable value (MEV). In this post geared toward technical readers, we'll propose a new design for order matching and consensus which eliminates transaction reordering and censorship MEV. This is a more robust solution which helps further level the playing field for traders on the dYdX Chain.MEV in order-driven marketsBefore delving into our proposed architecture, it's essential to understand the kinds of MEV that are most important in order-driven markets.MEV arises when block proposers change transaction inclusion and order to their benefit. Much has been said about reordering MEV, but arbitrary inclusion is just as important, especially in order-driven markets.Indeed, we expect a large fraction of MEV to derive from CEX-DEX arbitrage, and more generally from competition between sophisticated makers and takers, which is sensitive to inclusion guarantees. The protocol must ensure that this competition is fair and results in deep liquidity at reasonable prices.Although solutions like Flashbots MEV-Boost foster fair competition, they also risk creating a two-tiered order submission system. This system diverts value away from the protocol towards block proposers. Ideally, makers and takers should compete solely on order prices, not on privileged access costs, thereby channelling value exclusively towards liquidity and price formation.Think of order-driven markets as a game between high-frequency makers and takers:Makers compete to be first in line to offer liquidity at good prices, and to react first when prices change. Takers race with each other to trade against mispriced orders before makers are able to cancel. This race occurs countless times per second, all day, every day. Small changes in winning odds result in large profits or losses.In this context, MEV may involve proposers subtly tipping this competitive balance, which is perfectly achievable even without granular transaction reordering. This is why our MEV solution must go beyond the prevention of sandwiching.To see why, consider what a malicious proposer can achieve purely through the censorship or arbitrary inclusion of transactions.The importance of censorship and arbitrary inclusion for MEVWhen building a block, a proposer typically has the power to censor transactions or include new ones at the last instant.For any block, there is a public transaction submission deadline followed by a period where only the proposer can act. During this interval, proposers can exploit arbitrary inclusion power to act on new information first, inserting transactions into the block to trade against stale orders.Worse still, a taker permitted to censor competing taker orders or maker cancels could extract even more MEV from stale orders. And a maker with the same power would have the option to withdraw from unfavorable trades just before broadcasting a block.Given these challenges, curbing MEV requires a mechanism that does not concede unilateral censorship and inclusion powers to proposers.Solution: collaborative block building and frequent batch auctionsOur solution has two components:Collaborative block building. Typically, a proposer has sole responsibility for a block's contents, which makes it impossible to prevent MEV from censorship or arbitrary inclusion. Cosmos's new ABCI++ includes a feature called vote extensions, which allows multiple validators to jointly decide a block's contents. In Frequent Batch Auctions (FBA), orders are grouped together in batches. Each batch undergoes an auction and a single uniform price is chosen to maximize traded volume. Orders whose limit prices cross the uniform price are matched by price priority. If multiple orders share the same price, they participate in trades pro-rata. The key advantage for MEV mitigation is that the sequence in which transactions arrive doesn't influence how they're matched.In our proposed architecture, the process of building a block at height h and settling trades is:At block height h - 1, validators sign vote extensions containing hashes for each order seen to match in the FBA ending at vote extension time. The proposer of block h includes ≥ 2/3rds of vote extensions by stake weight, which is the same proportion needed to approve a block. These are the "included" vote extensions. For block h, the proposer runs a FBA. They include an order only if its hash appears in over half the included vote extensions by stake weight, then add all trades to the block. Since block h's trades result deterministically from the included vote extensions and the underlying orders, each validator can verify the computation independently.This algorithm has various implementations with different tradeoffs. For example, one variation reduces the size of vote extension data but introduces a slight delay. If the FBA is defined to end at block proposal time, instead of vote extension time, and the proposer at h - 1 references orders for inclusion in block h's auction, validators can then vote yes/no on the proposed orders with a series of 0 or 1 bits, and only include full hashes for orders excluded by the proposer. The optimal implementation will ultimately depend on the performance characteristics of vote extensions.PropertiesThis architecture provides the following benefits:The proposer does not have unilateral control over inclusion. Any order referenced in ≥ 2/3rds of all vote extensions is guaranteed inclusion, and any order not referenced in at least 1/3rd cannot be included. High-frequency makers and takers still compete amongst themselves, but they compete on price, to the benefit of other market participants. The value of colocation with the proposer is greatly reduced. Winning the latency race means disseminating a transaction to a majority of the network, not just one participant. In the same vein, this design disrupts order submission timing games — since the time it takes for a transaction to reach 2/3rds of the network is inherently variable — which improves the visibility of the market state throughout the auction. This has a similar effect to the London Stock Exchange's randomization of auction timingLooking aheadAs vote extensions enter the Cosmos ecosystem, we're excited to roll up our sleeves and prototype this architecture to understand its impact on trading beyond MEV, before recommending it for adoption by the dYdX Chain. Our commitment remains unwavering: to continually assess challenges facing the dYdX Chain and tackle them head-on. Onwards.Disclaimer and TermsThis document may provide information with respect to the default settings of dYdX Trading Inc. ("dYdX") v4 software ("dYdX Chain") or non-mandatory guidelines and suggestions that may help with using v4 software. dYdX does not deploy or run v4 software for public use, or operate or control any dYdX Chain infrastructure. dYdX is not responsible for any actions taken by other third parties who use v4 software. dYdX services and products are not available to persons or entities who reside in, are located in, are incorporated in, or have registered offices in the United States or Canada, or Restricted Persons (as defined in the dYdX Terms of Use). The content provided herein does not constitute, and should not be considered, or relied upon as, financial advice, legal advice, tax advice, investment advice or advice of any other nature, and you agree that you are responsible to conduct independent research, perform due diligence and engage a professional advisor prior to taking any financial, tax, legal or investment action related to the foregoing content. 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In this article, I will discuss the Best Aggregator To Discover Bridging Deals as they allow users to cross chains at the efficiency and cost they desire. You have a multitude of platforms, each of which has a specific set of features such as streamlined routing, minimal fees, and high-speed transfers. Hence, knowing which aggregator fits your specific requirements is crucial in achieving smooth and safe transfer of assets across different blockchain networks. PlatformKey FeatureChainArqDecentralized bridge offering cross-chain communication.MetaMask BridgesProvides a simple way to transfer assets between blockchains.Rango ExchangeAggregates multiple liquidity sources for seamless swaps.LlamaSwapDecentralized exchange with cross-chain liquidity options.OpenOceanCross-chain DEX aggregator for optimized trades.ParaSwapDeFi aggregation platform focusing on optimal routing.Celer cBridgeFast and scalable cross-chain transfer protocol.Synapse ProtocolEnables cross-chain asset transfers and liquidity sharing.Across ProtocolFocuses on low-cost, fast bridging of assets across chains.Jupiter ExchangeSolana-based aggregator for efficient token swaps. ChainArq distinguishes itself from its competitors as the leading aggregator for crypto cross bridging deals thanks to its user-friendly interface and integration with many blockchain systems. Unlike other services, it effectively combines the best rates and routes for cross chain transfers so users can find the most affordable bridging deals. Its algorithm uses more sophisticated methods to picking paths for transactions which guarantees the lowest possible fees and the fastest speeds. ChainArq focuses on users and still provides efficient decentralized cross chain bridging. FeatureDescriptionProject NameChainArqPurposeCrypto swap, DEX, and bridge aggregator for optimizing trades and bridging dealsSupported AssetsSupports thousands of tokens across multiple blockchainsPlatform AvailabilityAvailable as a web app and mobile appSecurityUtilizes blockchain technology for secure transactions and asset ownershipLedger SupportIntegrates with Ledger hardware wallets for enhanced securityFiat-Crypto IntegrationSupports buying, selling, and holding cryptocurrencies with minimal KYC requirementsUser ExperienceUser-friendly interface with advanced trading tools and seamless cross-chain transactionsWebsiteChainArq MetaMask Bridges is among the best aggregators for finding bridging deals due to its integration with the well-known MetaMask wallet. It requires little to no prior experience to use, making it easier to access cross-chain transactions across multiple chains. In addition, the MetaMask suite of crypto products makes it easy for users to identify supported bridges that provide the best and least expensive options for their asset transfers. A MetaMask account is all thats needed to access these bridging deals, ensuring strong security and account integration. FeatureDescriptionProject NameMetaMask BridgesPurposeBridge aggregator for optimizing token swaps and bridging dealsSupported AssetsSupports ETH, WETH, common stablecoins (e.g., DAI), and native gas tokens (e.g., MATIC)Platform AvailabilityAvailable on MetaMask Extension and MetaMask PortfolioSecurityUtilizes blockchain technology for secure transactions and asset ownershipLedger SupportIntegrates with Ledger hardware wallets for enhanced securityFiat-Crypto IntegrationSupports buying, selling, and holding cryptocurrencies with minimal KYC requirementsUser ExperienceUser-friendly interface with advanced trading tools and seamless cross-chain transactionsWebsiteMetaMask Bridges Bridging deals can be easily identified using Rango Exchange's unique way of bridging liquidity from several DEXs and bridges which makes it stand out as the ideal deal aggregator. In addition, users are given increased access to multiple cross-chain options, ensuring optimized and economical routes for transactions. Its smart routing system selects the bracket within which each bridge's price and speed is optimal, resulting in exceptional user experience with minimal slippage. It is the speed of execution and the multi-chain compatibility of Rango that makes it one of the top contenders in bridging deals. FeatureDescriptionProject NameRango ExchangePurposeCross-chain DEX and bridge aggregator for optimizing token swaps and bridging dealsSupported AssetsSupports a wide range of tokens across multiple blockchainsPlatform AvailabilityAvailable as a web app and mobile appSecurityUtilizes blockchain technology for secure transactions and asset ownershipLedger SupportIntegrates with Ledger hardware wallets for enhanced securityFiat-Crypto IntegrationSupports buying, selling, and holding cryptocurrencies with minimal KYC requirementsUser ExperienceUser-friendly interface with advanced trading tools and seamless cross-chain transactionsWebsiteRango Exchange LlamaSwap's focus on offering cross-chaining liquidity with very little slippage makes it the top aggregator when it comes to finding bridging deals. LlamaSwap's model opens the door for connecting users to a wide variety of liquidity across different chains, enabling the most efficient bridging routes. LlamaSwap has set itself apart with its innovation that allows users to select paths for transferring assets in a manner that is most optimal in transit speed, transfer costs, and security. With such a well developed ecosystem as well as its meager fees on transactions, the platform is preferred for effortless bridging. FeatureDescriptionProject NameLlamaSwapPurposeMeta DEX aggregator for optimizing token swaps and bridging dealsSupported AssetsSupports a wide range of tokens across multiple blockchainsPlatform AvailabilityAvailable as a web app and mobile appSecurityUtilizes blockchain technology for secure transactions and asset ownershipLedger SupportIntegrates with Ledger hardware wallets for enhanced securityFiat-Crypto IntegrationSupports buying, selling, and holding cryptocurrencies with minimal KYC requirementsUser ExperienceUser-friendly interface with advanced trading tools and seamless cross-chain transactionsWebsiteLlamaSwap When it comes to tracking bridging offers, OpenOcean takes the top spot as it houses the most sophisticated cross-chain liquidity aggregation. It integrates many DEXs and bridges to provide users with the best possible routes for asset transfers. OpenOcean's sophisticated algorithm guarantees users the most favorable prices and minimum slippage since all the most efficient paths are already predetermined. OpenOcean utilizes a unique approach where both the speed and cost of the user's transactions are the priority. This enhances the user's experience by providing smooth and reliable bridging solutions across multiple blockchains. FeatureDescriptionProject NameOpenOceanPurposeDEX aggregator for optimizing token swaps and bridging dealsSupported AssetsSupports a wide range of tokens across multiple blockchainsPlatform AvailabilityAvailable as a web app and mobile appSecurityUtilizes blockchain technology for secure transactions and asset ownershipLedger SupportIntegrates with Ledger hardware wallets for enhanced securityFiat-Crypto IntegrationSupports buying, selling, and holding cryptocurrencies with minimal KYC requirementsUser ExperienceUser-friendly interface with advanced trading tools and seamless cross-chain transactionsWebsiteOpenOcean ParaSwap is a perfect cross chain swap aggregator because it utilizes an advanced algorithm which helps users to save the most money on cross-chain transfers. It aggregates liquidity from a variety of DEXs and bridges, automatically picking the best ones in regard to cost, time, and slippage. The best aspect of ParaSwap that distinguishes it from competitors is its unique optimization of token swaps and bridging to a single transaction, allowing users to incur lower fees on several blockchains. It never compromises with user experience. FeatureDescriptionProject NameParaSwapPurposeDEX aggregator for optimizing token swaps and bridging dealsSupported AssetsSupports a wide range of tokens across multiple blockchainsPlatform AvailabilityAvailable on Ledger Live and as a web appSecurityUtilizes blockchain technology for secure transactions and asset ownershipLedger SupportIntegrates with Ledger hardware wallets for enhanced securityFiat-Crypto IntegrationSupports buying, selling, and holding cryptocurrencies with minimal KYC requirementsUser ExperienceUser-friendly interface with advanced trading tools and seamless cross-chain transactionsWebsiteParaSwap Its fast, safe, and scalable cross-chain transfer protocol makes Celer cBridge the best aggregator for discovering bridging deals. It uniquely uses its layer 2 technology to achieve low-cost, high-speed asset transfers across multiple blockchain networks. Celer cBridge stands out with the economic focus on transaction costs while ensuring security and decentralization. Highly efficient bridging routes result because users get the best of both worlds, full compatibility with various chains and fast execution times, which puts it among the leaders for optimized deals. FeatureDescriptionProject NameCeler cBridgePurposeHigh-speed, low-fee bridge for cross-chain token transfersSupported AssetsSupports canonical assets across multiple blockchainsPlatform AvailabilityAvailable on web and mobile platformsSecurityUtilizes intents-based framework for secure and efficient transactionsLedger SupportIntegrates with Ledger hardware wallets for enhanced securityFiat-Crypto IntegrationSupports buying, selling, and holding cryptocurrencies with minimal KYC requirementsUser ExperienceUser-friendly interface with fast and cost-effective bridging solutionsWebsiteCeler cBridge Synapse Protocol is the best aggregator for discovering bridging deals because Synapse stands out by focusing on transaction cost reduction, low latency, providing users fast and efficient bridging. These methods guarantee fast cross-chain transactions and offer high liquidity Synapse enables seamless and secure blockchain interactions through. its unique cross-chain messaging protocol There is no better alternative when it comes to finding the best optimized bridging routes due to the platforms decentralized nature paired with strong liquidity pools. FeatureDescriptionProject NameSynapse ProtocolPurposeDecentralized cross-chain bridge for token and data transfersSupported AssetsSupports canonical assets across multiple blockchainsPlatform AvailabilityAvailable on web and mobile platformsSecurityUtilizes intents-based framework for secure and efficient transactionsLedger SupportIntegrates with Ledger hardware wallets for enhanced securityFiat-Crypto IntegrationSupports buying, selling, and holding cryptocurrencies with minimal KYC requirementsUser ExperienceUser-friendly interface with fast and cost-effective bridging solutionsWebsiteSynapse Protocol Within cross-chain dealings, Across Protocol stands out as the leading aggregator in finding bridging deals due to its unique approach to cost-efficient, rapid cross-chain transfers. The novel aspect that sets Across apart is its use of optimistic rollups alongside bridging, where transaction finality is prioritized. This ensures liquidity provision across chains and efficient bridging. Users who favor unmatched cross-chain transaction s tend to use Across due to its unique blend of minimal fee requirements, security, and speed. FeatureDescriptionProject NameAcross ProtocolPurposeHigh-speed, low-fee bridge for cross-chain token transfersSupported AssetsSupports canonical assets across multiple blockchainsPlatform AvailabilityAvailable on web and mobile platformsSecurityUtilizes intents-based framework for secure and efficient transactionsLedger SupportIntegrates with Ledger hardware wallets for enhanced securityFiat-Crypto IntegrationSupports buying, selling, and holding cryptocurrencies with minimal KYC requirementsUser ExperienceUser-friendly interface with fast and cost-effective bridging solutionsWebsiteAcross Protocol Jupiter Exchange is the best aggregator for finding bridging deals, especially in the scope of the Solana ecosystem. Its crowning feature is the ability to aggregate liquidity from multiple Solana-based DEXs, providing users the best rates at low slippage. Jupiter intelligent routing system accepts numerous cross-chain transfers, and automatically chooses the most cost-effective path for the transaction. Aiming to capitalize on Solana's low fees and high transaction speeds, Jupiter users enjoy smooth and efficient bridging solutions. Thus it is best suited for users looking for optimized deals. FeatureDescriptionProject NameJupiter ExchangePurposeDecentralized exchange aggregator for optimizing token swaps and bridging dealsSupported AssetsSupports a wide range of tokens, including SOL, USDC, and memecoinsPlatform AvailabilityAvailable on the Solana blockchainSecurityUtilizes blockchain technology for secure transactions and asset ownershipLedger SupportIntegrates with Ledger hardware wallets for enhanced securityFiat-Crypto IntegrationSupports buying, selling, and holding cryptocurrencies with minimal KYC requirementsUser ExperienceUser-friendly interface with advanced trading tools like limit orders, DCA, and perpetualsWebsiteJupiter Exchange Ultimately, the most effective way to identify bridging deals is through an aggregator that best suits the user's requirements, be it speed, cost, or the blockchain in question. While ChainArq, MetaMask Bridges, and Rango Exchange are great at providing optimized routes, Celer cBridge and Synapse Protocol gems are known for their lower security-centric and lower tier fee structure. Despite the fundamental differences in offerings, all add-on utility functions serve a single purpose of facilitating effortless cross-chain transfers and delivering the most optimal bridging deals for effortless and effective transfer of assets across networks. There's been growth in Blockchain ecosystems, and alongside this expansion, many chains have emerged. This brings a fundamental issue – the effective movement of assets between these chains. That's where aggregators, the bridges in this scenario, become invaluable. These platforms simplify the process of transferring tokens across different blockchains by pooling together multiple bridging solutions into one seamless interface. In this blog, we'll explore how bridge aggregators like LI.FI optimizes token transfers and why multichain bridges are crucial for today's decentralized finance (DeFi) world. The growth of decentralized applications (dApps) on various blockchains, including Ethereum, Binance Smart Chain, and Polygon, amplifies the need for asset transfers between networks. Yet, the independence of each blockchain complicates direct token transfers. In a scenario without bridges, users find themselves trapped within a single network, unable to deploy their assets on different networks or seize opportunities on various platforms. An answer to this issue is a multichain bridge. This tool facilitates the movement of assets between blockchains through a bridging protocol. But with a variety of bridges to choose from, users must figure out which one provides optimal performance, low costs, and rapid transaction times. LI.FI and similar bridge aggregators tidy up the user interface by acting as a central mediator, combining separate bridging solutions and offering a superior choice for each token shift. Users are spared from having to investigate and weigh up distinct bridges, as aggregators employ algorithms to pinpoint the most efficient path for transfers taking speed, cost, and security into account. As an example, when transferring tokens from Ethereum to Avalanche, a bridge aggregator conducts an evaluation of various multichain bridges before providing the most effective option. This method does more than just save time; it ensures that users receive the best experience without having to manually scour numerous platforms. Additionally, bridge aggregators can integrate value-added features like token swaps, cross-chain liquidity sourcing, or transaction batching, further enriching the experience while promoting interoperability across various blockchain networks. One of the standout bridge aggregators in this space is LI.FI. It integrates a wide array of bridging protocols, allowing users to seamlessly transfer tokens across numerous blockchains without worrying about the technical complexities involved. LI.FI provides users with real-time data, ensuring they always choose the most optimal route for their token transfers. Here's why LI.FI stands out: Wide bridge integration: LI.FI aggregates over 10 of the most popular blockchain bridges, offering extensive cross-chain support. Real-time optimization: The platform continuously monitors fees, speeds, and liquidity across bridges, offering the best options in real time. Security-first approach: LI.FI only works with reputable, secure bridges, ensuring users can move assets safely across chains. If you're looking for an easy, reliable way to move your assets across different blockchains, platforms like LI.FI are leading the charge in optimizing token transfers. Embrace the multichain future and explore the power of bridge aggregators today! This is an excerpt from the Quarterly Insights Q3 2023 report. Find the full report, here. Staking rewards generally derive from a combination of inflationary rewards, transaction fees, and MEV. We are certain that a complete understanding of the Ethereum PBS pipeline allows validators to extract more MEV through targeted infrastructure optimizations. While adjacent topics have been discussed in literature (e.g. Schwarz-Schilling et al., 2023), Chorus One is the first node operator to successfully test out different optimization approaches on mainnet. We find that the most impactful improvements are contingent on comprehensive internal data, and have generally not been discussed in their specificity.The goal of this article is to share the results of a recent pilot. We will follow-up with more detail in a later, comprehensive study, which we are co-authoring with one of the most recognizable and competent teams in the MEV space.The pilot makes use of several modifications which positively impact MEV extraction. The rest of the article will discuss one straightforward, illustrative example in more detail, and present the overall results of the pilot so far.There are two components to APR optimization. Firstly, we should maximize the payoff of the blocks we propose, and secondly, we should minimize the likelihood of missing our chance to propose (i.e. missing our slot). The first of these is more complex and can be approached in several ways, including via latency games, and other infrastructure optimizations.The latter is more accessible, and primarily hinges on running a robust infrastructure setup with appropriate redundancy. However, relay selection also plays a role. Let's dive in!A basic illustrative adjustment: drop underperforming relaysThe goal of this section is to give an example of a straightforward MEV-adjacent infrastructure adjustment that can positively impact validator APR by minimizing the probability of a missed slot. This modification is not central to our MEV strategy in terms of impact, but it is illustrative of the Ethereum MEV supply chain. As per conventional wisdom, a validator is best off integrating with a large number of relays, as the mev-boost auction will yield the highest bid, i.e. there is no obvious downside to soliciting a maximum number of bids.This is only half of the story. Let's recall how validators and relays interact in more detail. First, the validator requests a block header from a relay, which then delivers the header corresponding to the most profitable block available to the relay. In parallel, the validator also solicits bids from all other relays it is integrated with. The mev-boost auction then determines the highest bid, the validator signs the header associated with this bid, and asks all relays to deliver the payload associated with this header. The relay that is quickest to respond (typically the relay that delivered the original bid) then broadcasts the block and returns the associated payload to the proposer. This may be done with a delay versus previous implementations (i.e. at proposer's slot t=0), as early distribution of the payload theoretically allows an unethical proposer to build an alternative block exploiting the transactions in the block received from the relay. This vulnerability has been outlined by the "low carb crusader", and more details can be found in this post by Flashbot's Robert McMiller. The upshot is that in addition to transferring bids from builders, relays also carry responsibility for propagating the final signed block to the network. This is more pronounced now than previously, as the time available for this step has been decreased. Therefore, validators should favor relays that deliver payloads rapidly, or run an idiosyncratic risk of missing their slot, for relays that underperform.In practical terms, we find that relays can diverge significantly on delivery speed, and that for one relay in particular, a routine network disturbance could lead to a missed slot if the validator depends on it to deliver a given block.The following graph shows the cumulative probability distribution for the maximum time at which a block becomes eligible within each slot, and each line represents a relay.This is a snapshot that is relative to a subset of our nodes over a limited period, and relay performance can vary over time, i.e. should be constantly and granularly monitored. Relays are currently a costly pro-bono good, and we appreciate providers subsidizing the network in this way. In practical terms, for this particular cluster of nodes, running the relay color-coded light blue is a negative EV decision, i.e. it should be dropped. This is due to the consistent delay it exhibits in making blocks eligible, as compared to other relays.Our current MEV pilot: A first look at the resultsOur current MEV pilot combines straightforward adjustments, like the relay selection process illustrated above, with more significant and systematic infrastructure optimizations. The below graphs are a first look at the results, and summarize performance over approximately a quarter.As such, getting a grip on variance requires robust statistical processing. As MEV is tail-heavy (i.e. most profit is produced by rate opportunities), results can vary significantly over time, and capital invested. We are comparing the MEV payoff distribution of the pilot with the MEV payoff realized by a set of Lido nodes. On a per-block level, we find that our pilot has improved MEV rewards significantly:This extends to the aggregate case - over our sample, the pilot has extracted higher rewards than a "vanilla" setup with a probability approaching 100%:The upshot is that we feel highly confident that the infrastructure optimizations implemented in our pilot study aggregate out at an APR that is consistently higher than what a non-optimized setup typically achieves.We will elaborate further on specifics in a forthcoming study. If you are interested in learning more about our approach to MEV, please reach out to us anytime at research@chorus.one.About Chorus OneChorus One is one of the biggest institutional staking providers globally operating infrastructure for 45+ Proof-of-Stake networks including Ethereum, Cosmos, Solana, Avalanche, and Near amongst others. Since 2018, we have been at the forefront of the PoS industry and now offer easy enterprise-grade staking solutions, industry-leading research, and also invest in some of the most cutting-edge protocols through Chorus Ventures.