Understanding Uniswap v4

Uniswap Overview

Uniswap is DeFi's leading decentralized exchange (DEX) built on the Ethereum blockchain. This completely on-chain trading venue facilitates token swaps in a trustless manner, leveraging smart contracts to execute trades for a fee.

The key feature Uniswap helped popularize in DeFi's early days is its automated market maker (AMM) system. Rather than relying on order books to match buyers and sellers like with a traditional centralized exchange (CEX), Uniswap uses a mathematical formula that determines the trade price based on the ratio of assets in a liquidity pool. Uniswap's design allows users to create liquidity pools for ERC-20 tokens without the need for permissions or listing fees, thereby democratizing access to liquidity.

Uniswap's journey began with the launch of V1 in 2018, which introduced the concept of liquidity providers (LPs). LPs deposit ERC-20 cryptocurrencies into liquidity pools, providing the necessary liquidity for trades on the exchange. In return for their contribution, LPs earn fees from the trades executed within their pool.

Since its inception, Uniswap has continued to evolve, with the introduction of V2 in 2020, V3 in 2021, and its recent announcement of a forthcoming V4. Each iteration over the years have continued to bring about significant improvements to the platform, enhancing its functionality and user experience. Unlike many projects in DeFi, Uniswap's core logic and code is non-upgradeable. This is why a new version must be released each time a new fundamental change to the code is proposed, and is always why UNI versions 1,2, and 3 continue to operate and attract significant volumes.

V4 Announcement

In June 2023, Uniswap Labs released the preliminary version and draft code of Uniswap V4, along with its ideas for a release later in the year. The team also emphasized that the work is still very much ongoing and the code is by no means final. In fact, it is Uniswap Labs' hope that the community will build atop their initial design plans for V4 and help bring the project and code to a "production-ready" level, stating "We are releasing the draft code now so that V4 can be built in public, with open feedback and meaningful community contribution. We expect this will be a months-long process."

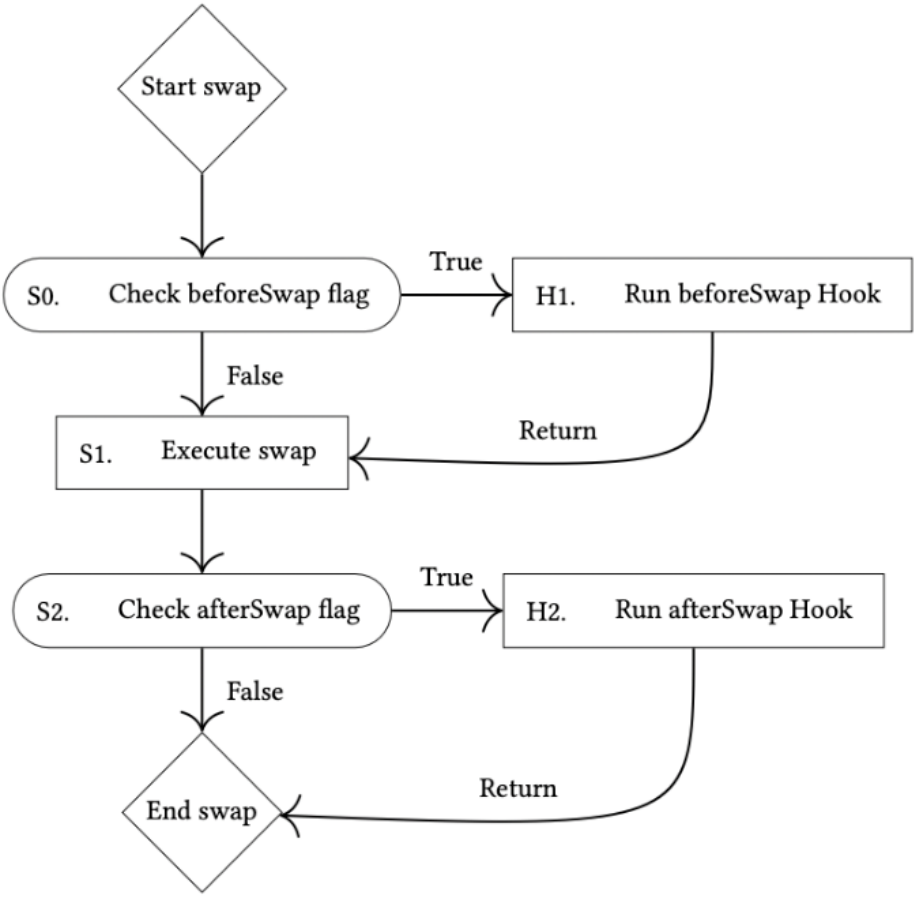
At a high-level, V4 looks to build atop V3's incredibly popular concentrated liquidity model by simply adding more flexibility and customizability to the liquidity pools while also improving gas optimization. The introduction of "hooks" enables a new design space for liquidity providers and developers while the singleton contract is responsible for driving down gas costs. Governance for Uniswap V4 will remain with the Uniswap Decentralized

Autonomous Organization (DAO) and UNI token holders. The protocol continues to feature a fee switch, allowing Uniswap governance to activate it on a per-pool basis, thus capturing a portion of the fees generated by liquidity providers.

Hooks

Hook contracts are externally deployed contracts that execute developer-defined logic at specific points in a pool's execution. This feature allows for the integration of smart contracts either before or after key operations such as swaps, liquidity provision, initialization, or even donations—a new feature that enables liquidity providers (LPs) to receive additional tips.

These contracts can be invoked at three critical points in a pool's lifecycle: onSwap, onMint, and onBurn.The onSwap hook is triggered during a typical exchange. This hook can be used to execute custom logic, like modifying transaction fees. The onMint hook is used when liquidity providers add liquidity to the pool. The enhanced customization due to the custom logic introduced by the hook provides developers with a powerful tool to monitor and manage liquidity provision. The onBurn hook is similar to the onMint hook but is called upon when liquidity providers withdraw liquidity from the pool. This feature gives users the ability to manage liquidity withdrawals in a way that was not possible in prior Uniswap versions.

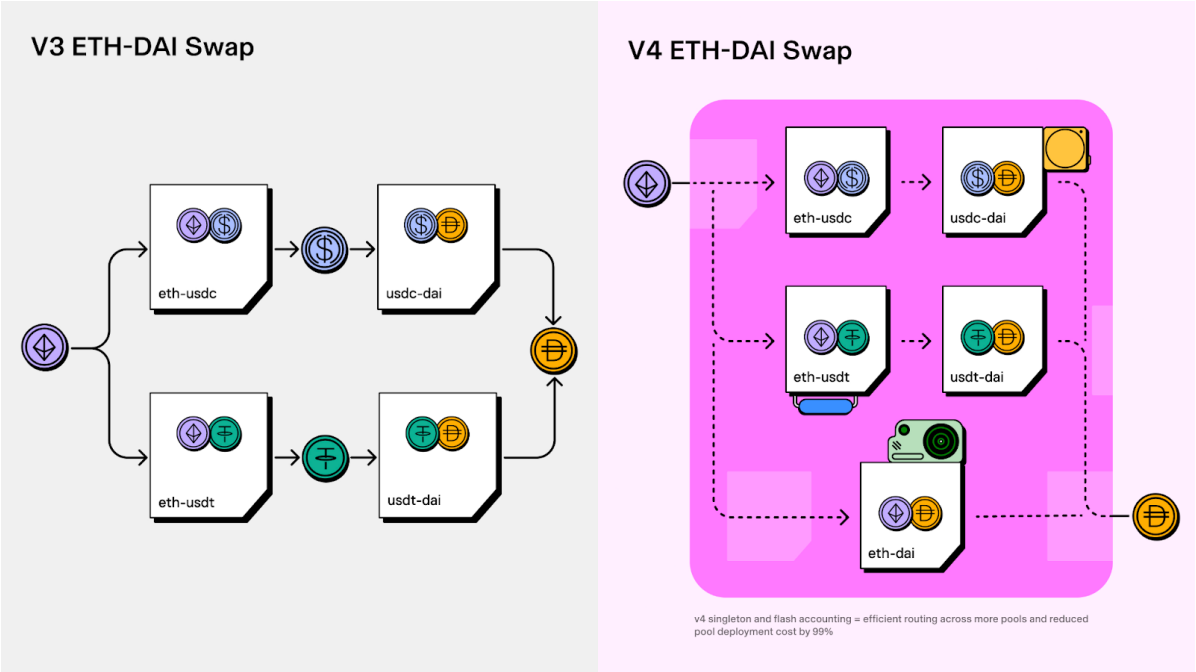


An example workflow for a Uniswap trade utilizing the new hooks contracts. Source: LD Capital

The introduction of hooks opens up a world of new features for Uniswap devs, traders, and LPs. Some early ideas include enabling on-chain limit orders, custom price oracles, and even dynamic fees that can respond to market conditions. Additionally, hooks enable liquidity to be leveraged differently than in prior Uniswap versions. Mirroring Balancer's 'boosted pools,' hooks permit the deployment of a pool's out-of-range liquidity into alternate protocols like lending platforms, to accrue additional yield. These new features represents a significant advancement in the DeFi space, providing developers with the tools they need to create a more responsive and creative DEX user experience.

The Singleton Contract

V4 also introduces a feature known as the "singleton," a solitary contract that houses all of Uniswap V4's Total Value Locked (TVL) across all pools. This one change reduces the gas costs on V4 by an estimated ~99% when compared to V3. This is a significant design change when compared to previous versions that utilized separate contracts for each individual pool. Complex swaps within Uniswap's AMM design previously required interaction with multiple contracts but, now with V4 and the singleton design, they can now be routed through a single contract.



Source: [Uniswap blog]

In addition to the singleton, Uniswap V4 employs a novel "flash accounting system," which significantly alters the way in which transactions are conducted. Previously in V3, tokens were transferred after *every operation* (swap and/or LP position). This process, while straightforward, is extremely costly for the enduser in multi-hop swapping scenarios.
In V4, instead of necessitating a token transfer after each operation, flash accounting allows for an internal balance update, transferring only the *net balance* of tokens out of a pool. The flash accounting system operates by updating a delta value for each operation. This ensures that at the end of the call, neither the pool nor the user are owed funds, proving the solvency of pools. By ensuring that no tokens are owned by the pool manager at the end of

the transfer, Flash Accounting safeguards the financial stability of the pools. This is a critical feature, as it enhances the security and reliability of the cryptocurrency ecosystem.

V4 Concerns

Additional Complexity and New Attack Vectors

Initially, the idea of being an LP in a Uniswap liquidity pooled seemed quite simple and hands-off. Simply deposit two tokens, accrue your portion of the pool's fees, and remove your liquidity whenever. However, over time, this has proven to be an oversimplified depiction as profitably LP'ing into most token pairs has proven to be impossible for most due to issues such as impermanent loss, toxic flow, issues surrounding MEV, and more. These issues were only amplified with the introduction of concentrated liquidity in V3.

Although enormous efficiency gains introduced, gone were the days of profitable passive LP strategies. Post V3, (generally) only the most sophisticated, hands-on, and well-capitalized LPs were able to run successful LP strategies. Now, with the introduction of V4 and hooks, the complexity has been upped yet again. While the optionality and positives of hooks seem inarguable, they do add another level of complexity to each transaction and liquidity position that users will have to grapple with.

They also introduce additional smart contract risk and new attack vectors.Given the growing sophistication of DeFi exploits, hooks may be yet another tool for hackers and scammers to look to exploit. Additionally, hooks could pose significant challenges for MEV developers and trading aggregators such as 1inch and 0x. However, one positive aspect of V4 as it relates to MEV is the introduction of an internalized MEV allocation mechanism, providing opportunities for MEV developers to occupy advantageous roles in V4 pools rather than exploitative.

BSL License vs Open Source

V4 is slated to be released under a Business Source License 1.1, restricting the protocol's use to only those entities approved by governance. The BLS license limits other developers' access to its code for a period of four years. This approach, while not totally foreign to Uniswap, is somewhat antithetical to the "open source" mentality that permeates much of DeFi. Adding to the controversy, Uniswap initially branded its V4 release as open-source, a claim that was met with skepticism given the restrictions imposed by the BSL.

Uniswap's decision to gate its code behind a BSL has raised questions about its commitment to open-source development. The DeFi community, which values transparency and collaboration, has traditionally embraced open-source protocols. These protocols allow anyone to use, modify, and distribute the code without requiring the creator's permission. By contrast, a BSL restricts the use of the code, rendering it effectively proprietary.

Conclusion

While Uniswap V4 is not yet live, it is but the latest iteration in the ever-evolving DeFi space. Once it does finally launch, VB4 is poised to significantly impact various aspects of the DeFi ecosystem, from aggregators to CEXs, and even oracle services. With its enhanced features, Uniswap V4 is set to reshape the DeFi landscape and redefine the rules of the game.