

L35: Uniswap Deep Dive

Module E: DeFi Ecosystem

Blockchain & Cryptocurrency

December 2025

- Trace Uniswap's evolution from V1 to V4
- Understand concentrated liquidity mechanics (V3)
- Analyze fee tier optimization
- Explore UNI token governance and the fee switch debate
- Case Study: Fee switch governance controversy

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Launch Timeline:

- **November 2018:** Uniswap V1 launches
- **May 2020:** Uniswap V2 with ERC-20/ERC-20 pairs
- **May 2021:** Uniswap V3 with concentrated liquidity
- **June 2024:** Uniswap V4 announced (hooks and singleton contracts)

Market Position:

- Largest DEX by volume (\$50B+ monthly)
- \$3.5B TVL (Dec 2024)
- Deployed on Ethereum, Polygon, Arbitrum, Optimism, Base, BNB Chain

Impact: Pioneered AMM model, inspired hundreds of forks.

Key Features:

- ETH/ERC-20 pairs only (no direct ERC-20/ERC-20)
- Constant product formula: $x \cdot y = k$
- 0.3% trading fee (100% to LPs)
- Simple, audited, gas-efficient

Limitations:

- Multi-hop trades required for ERC-20/ERC-20 (e.g., DAI \rightarrow ETH \rightarrow USDC)
- Double fees and slippage on multi-hop
- No price oracles
- Fixed fee tier

Innovation: Proved AMM model viable on Ethereum.

Major Improvements:

- **ERC-20/ERC-20 pairs:** Direct trading without ETH intermediary
- **Price oracles:** Time-weighted average price (TWAP) for other protocols
- **Flash swaps:** Borrow any token, repay in same transaction
- **Protocol fee switch:** Potential 0.05% fee to UNI holders (not activated)

TWAP Oracle:

- Accumulates price over time
- Resistant to flash loan manipulation
- Used by lending protocols (Compound, Aave)

Flash Swaps:

- Borrow tokens, use in DeFi, repay + fee in one transaction
- Enables arbitrage without upfront capital

Revolutionary Concept: LPs choose specific price ranges for liquidity.

How It Works:

- Instead of infinite range (\$0 to ∞), LP sets bounds (e.g., \$1,900-\$2,100 for ETH)
- Liquidity only active within range
- Earns fees only when price in range
- If price exits range, position becomes 100% one token

Example:

- LP deposits 1 ETH + 2,000 USDC with range \$1,900-\$2,100
- If ETH price = \$2,000: Position active, earns fees
- If ETH price = \$2,200: Position fully in USDC, no fees
- If ETH price = \$1,800: Position fully in ETH, no fees

Advantage: Achieve same liquidity depth with less capital.

Comparison:

- **V2 LP:** Deposits \$100,000 across entire price range (\$0 to ∞)
- **V3 LP:** Deposits \$10,000 in tight range (\$1,900-\$2,100)
- **Result:** V3 LP provides same liquidity in relevant range with 10x less capital

Capital Efficiency Factor:

- Depends on range width
- Narrow range (e.g., \$1,980-\$2,020): Up to 200x efficiency
- Wide range (e.g., \$1,000-\$4,000): 2-5x efficiency

Trade-off: Higher returns but requires active management.

Challenge: Price may exit your range, requiring rebalancing.

Strategies:

❶ **Passive (Wide Range)**

- Set very wide range (e.g., \$1,000-\$5,000)
- Lower returns but minimal management

❷ **Active (Narrow Range)**

- Set tight range around current price
- High returns if price stable
- Rebalance frequently as price moves

❸ **Automated (Vault Services)**

- Use Gamma, Arrakis, Charm to auto-rebalance
- Pay management fee (0.1-0.5%)

Gas Costs: Rebalancing requires withdrawing and redepositing (expensive on Ethereum L1).

Innovation: Multiple fee tiers for same pair.

Fee Tier	Use Case	Example Pairs
0.01%	Stablecoins	USDC/USDT, DAI/USDC
0.05%	Correlated assets	ETH/stETH, WBTC/tBTC
0.3%	Standard pairs	ETH/USDC, WBTC/ETH
1%	Exotic/volatile	Low-liquidity tokens

Rationale:

- Stablecoins: Low price risk, low fees attract volume
- Volatile pairs: High impermanent loss, higher fees compensate

Impact: Most liquidity in 0.05% and 0.3% tiers.

Change from V2:

- V2: LP tokens are fungible ERC-20s
- V3: LP positions are unique NFTs (ERC-721)

Why NFTs?

- Each position has custom price range
- Cannot standardize (different ranges, different values)
- NFT represents specific position parameters

Implications:

- **Positive:** Flexibility, capital efficiency
- **Negative:** Harder to integrate with DeFi (less composability)

Solution: Wrapper protocols (Gamma, Arrakis) create fungible tokens representing V3 positions.

Key Innovation: Customizable pool behavior via hooks.

What are Hooks?

- Smart contracts that execute at specific points in trade lifecycle
- Before/after swap, before/after adding liquidity, etc.
- Developers can add custom logic without forking Uniswap

Example Use Cases:

- Dynamic fees based on volatility
- On-chain limit orders
- TWAP execution
- Auto-rebalancing liquidity
- Custom oracles
- MEV protection mechanisms

Singleton Contract: All pools in one contract (gas savings).

Launch: September 2020 (retroactive airdrop of 400 UNI to every user)

Token Supply:

- Total: 1 billion UNI
- Community airdrop: 15% (150M)
- Team/investors/advisors: 40% (4-year vesting)
- Community treasury: 43% (governed by UNI holders)

Governance Rights:

- Vote on protocol upgrades
- Treasury allocation (billions in assets)
- Fee switch activation (controversial)
- Cross-chain deployment approvals

Voting: 1 UNI = 1 vote (can delegate).

Proposal Threshold: 2.5M UNI to propose, 40M quorum to pass.

Current State:

- 0.3% trading fee goes 100% to LPs
- Protocol fee switch can redirect 0.05% (1/6th) to UNI holders

Arguments For Activation:

- Value accrual for UNI token (currently only governance utility)
- Sustainable revenue for protocol development
- Competitive with other DEXs (SushiSwap shares fees)
- Treasury accumulation for grants/operations

Arguments Against:

- Reduces LP returns (may lose liquidity to competitors)
- Regulatory risk (UNI could be deemed security if profit-sharing)
- Current model works (don't fix what's not broken)
- Complexity of distribution mechanism

Timeline:

- **Feb 2023:** Community proposal to activate fee switch
- **Debate:** Heated discussion on governance forum
- **Vote:** Proposal failed to reach quorum
- **Outcome:** Fee switch remains off (as of Dec 2024)

Key Issues:

- 1 **Regulatory Uncertainty:** SEC scrutiny of DeFi, especially revenue-sharing
- 2 **LP Exodus Risk:** Would LPs leave for SushiSwap, Curve, etc.?
- 3 **Distribution Complexity:** How to fairly distribute fees to UNI holders?
- 4 **Timing:** Bear market = bad time to reduce LP incentives

Current Status: Delayed indefinitely, may revisit in bull market.

UNI Token Utility (Current)

What UNI Holders Get:

- **Governance:** Vote on protocol decisions
- **Treasury Control:** Manage \$5B+ in assets
- **Deployment Approval:** New chains (e.g., BNB Chain vote)

What UNI Holders Don't Get (Yet):

- Trading fee revenue
- Staking rewards
- Dividends or buybacks

Value Proposition Debate:

- **Bulls:** Governance over massive treasury is valuable
- **Bears:** No cash flow = overvalued compared to fundamentals

Market Cap: \$5-7B (Dec 2024), making it top 20 crypto by market cap.

DEX	Key Feature	Fee Model	TVL
Uniswap V3	Concentrated liquidity	0.01-1% to LPs	\$3.5B
SushiSwap	Fork with fee sharing	0.25% LP, 0.05% xSUSHI	\$300M
Curve	Stablecoin optimized	0.04% + CRV rewards	\$2B
Balancer	Weighted pools	Variable, custom	\$800M
PancakeSwap	BSC native, low fees	0.25% LP, CAKE rewards	\$1.5B

Uniswap's Moat:

- Brand recognition and trust
- Deepest liquidity (lowest slippage)
- Innovation leadership (V3, V4)
- Integration with wallets and aggregators

Deployments (as of Dec 2024):

- Ethereum (L1)
- Polygon (sidechain)
- Arbitrum (L2 Optimistic Rollup)
- Optimism (L2 Optimistic Rollup)
- Base (Coinbase L2)
- BNB Chain (approved via governance)
- Celo (mobile-first L1)

Benefits:

- Lower gas fees on L2s (10-100x cheaper)
- Tap into different user bases
- Maintain dominance across ecosystems

Challenge: Liquidity fragmentation across chains.

Uniswap Foundation: Manages community treasury.

Grants Allocated:

- \$20M+ in grants since 2021
- Developer tooling (e.g., SDK improvements)
- Research (MEV, concentrated liquidity optimization)
- Community projects (analytics dashboards)
- Cross-chain infrastructure

Recent Major Grants:

- \$1.5M to Flipside Crypto (analytics)
- \$500k to GFX Labs (governance tooling)
- \$300k to Crocswap (V3 UI alternative)

Goal: Sustain ecosystem growth without protocol fee revenue.

Structure:

- **Uniswap Protocol:** Decentralized, governed by UNI holders
- **Uniswap Labs:** For-profit company that develops the protocol

Funding:

- \$165M Series B (2022) at \$1.66B valuation
- Investors: Polychain, a16z, Paradigm

Revenue Streams:

- No protocol fees (yet)
- Venture investment in tokens
- Potential: Interface fees, Uniswap X orderflow

Controversy: Some community concern about company vs. protocol alignment.

SEC Wells Notice (April 2024):

- Uniswap Labs received Wells notice (precursor to enforcement)
- Allegations: Operating unregistered securities exchange
- Uniswap response: Protocol is decentralized, Labs just builds software

Legal Arguments:

- Protocol vs. Interface distinction
- Smart contracts are speech (First Amendment)
- Users, not Uniswap, choose which tokens to list

Potential Outcomes:

- Settlement (delisting certain tokens, geo-blocking)
- Lawsuit (precedent-setting for DeFi)
- Favorable ruling (legitimizes decentralized protocols)

Status: Ongoing (as of Dec 2024), industry watching closely.

Key Takeaways:

- Uniswap evolved from simple AMM (V1) to concentrated liquidity (V3) to customizable hooks (V4)
- V3's concentrated liquidity provides 10-200x capital efficiency but requires active management
- Fee tiers optimize for different asset types (stablecoins 0.01%, standard 0.3%)
- UNI token governs protocol but lacks direct cash flow (fee switch debate)
- Uniswap dominates DEX market but faces regulatory scrutiny
- Multi-chain strategy expands reach but fragments liquidity

Next Lecture: Lab - Testnet Swap (hands-on experience with Uniswap).

- ❶ How does concentrated liquidity improve capital efficiency in V3?
- ❷ Why might activating the fee switch harm Uniswap's competitive position?
- ❸ What are the trade-offs of NFT-based LP positions in V3?
- ❹ How do hooks in V4 enable new DeFi primitives?
- ❺ Should Uniswap prioritize decentralization or regulatory compliance?