



URswap

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Abstract

URswap is a non-custodial automated market maker (AMM) designed for Binance Smart Chain (BSC). It facilitates smooth decentralized trading and liquidity supply through an innovative modular architecture, offering users unmatched adaptability. URswap improves on the conventional AMM framework by introducing a modular architecture that gives users adaptable choices. It offers a flexible and adaptable trading experience with features including staking mechanisms, cross-chain bridges, dedicated liquidity pools and staking. Customizable hook contracts are incorporated into the novel technique, allowing certain logic to be executed either before or after crucial actions inside a liquidity pool. These characteristics, along with the latest gas optimization strategies and effective liquidity mining incentives, guarantee that URswap will continue to be efficient, flexible, and sustainable for both users and developers.

1. Introduction

URswap is an innovative automated market maker (AMM) designed for the Binance

Smart Chain (BSC) that makes it easier to swap digital assets in an efficient, non-custodial manner. By building on the experiences of decentralized exchanges like Uniswap. URswap improves user experience, liquidity provisioning, and incorporates a number of features, including:

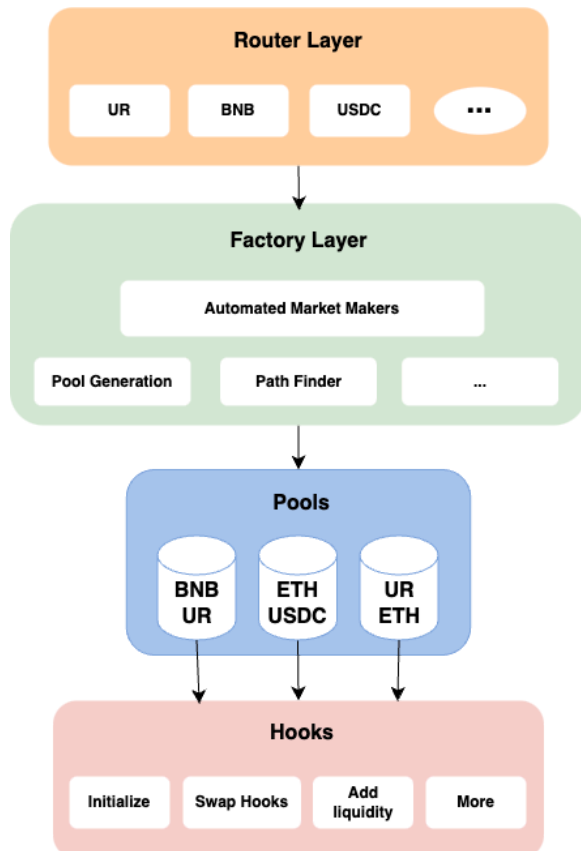
- **Staking Mechanisms:** Users can receive rewards by offering liquidity.
- **Cross-Chain Bridges:** Smooth transfers of assets across blockchain networks.
- **Customizable Hooks:** Developers can implement specific logic during critical pool operations.

URswap modular architecture allows developers to integrate custom hook contracts, which implement specific logic at critical pool operations. This feature enhances the flexibility of the platform, allowing advanced order types, dynamic fees, and efficient liquidity management.

By using the concentrated liquidity model from previous versions of CLAMM, URswap overcomes their shortcomings to provide a template for pool creators to customize within the framework while not changing the core protocol itself. Its efficient design reduces gas expenses and helps make asset swapping easier by supporting native assets, eliminating the need for wrapping. As DeFi evolves, URswap delivers a reliable, flexible, and cost-effective AMM platform, embracing the next generation of decentralized trading.

2. Architecture

URswap implements a three-layered modular architecture that consists of the Router, Factory, and Hooks. This structured approach ensures maximum flexibility and scalability within the platform.



3. Hooks

Hooks in URswap are externally deployed contracts that integrate with the core Automated Market Maker (AMM) and Pool Management logic. They allow developers and integrators to introduce customized logic at specific points in a pool's lifecycle. These hooks empower pool creators to design and deploy liquidity pools with flexible, dynamic, and innovative functionalities, enhancing user experience and protocol efficiency.

During the initialization of a pool, creators can specify a hook contract. The contract enables additional logic which can be executed before or after key pool operations, such as:

- Pool initialization
- Liquidity addition and removal
- Token swaps
- Fee management
- Donations to the pool

Supported Hook Callbacks

URswap supports the following ten hook callbacks, providing granular control over pool behavior:

- `beforeInitialize` / `afterInitialize`
- `beforeAddLiquidity` / `afterAddLiquidity`
- `beforeRemoveLiquidity` / `afterRemoveLiquidity`
- `beforeSwap` / `afterSwap`
- `beforeDonate` / `afterDonate`

These hooks facilitate a range of use cases, including but not limited to:

- **Dynamic Fee Adjustments:** Hooks can modify fees based on market conditions, enabling volatility-sensitive fee structures.
- **On-chain Limit Orders:** Execute trades only at predefined price levels.
- **Time-weighted Orders:** Implement mechanisms like Time-Weighted Average Market Maker (TWAMM) to handle large trades over extended periods.
- **Custom Oracles:** Integrate bespoke oracle solutions, including median or truncated price feeds.
- **Liquidity Mining Strategies:** Internalize MEV (Miner Extractable Value) to enhance rewards for liquidity providers.
- **Legacy AMM Compatibility:** Support constant product market maker models, preserving compatibility with traditional designs.
- **Withdrawal Fees:** Hooks can impose withdrawal fees directly, with all fee allocation managed within the hook logic.
- **Governance Revenue Sharing:** URswap governance can optionally receive a capped percentage of swap fees, ensuring alignment between governance incentives and pool performance.

4. Gas Optimizations

By incorporating advanced gas optimization techniques, URswap ensures an efficient trading experience for its users with minimized transaction costs. URswap employs an individual contract model for each liquidity pool, carefully designed to reduce redundant operations and storage costs. By utilizing lean data structures and efficient state updates, gas consumption is significantly reduced during swaps, liquidity provisioning, and other pool interactions.

Inspired by modern DeFi protocols, URswap implements **Flash Accounting** to reduce gas costs during transactions (Section 5.3)

5. Singleton Architecture

Unlike fully unified singleton designs, **URswap** employs a hybrid approach where each liquidity pool has its own dedicated contract, but core functionalities are orchestrated through a centralized **Pool Manager Contract**. This design strikes a balance between modularity and operational efficiency.

5.1 Modular Pool Contracts

Each liquidity pool in URswap operates through an independent contract, allowing for customized configurations, flexibility, and

3.1 Hook-based Fee Management in UrSwap

URswap introduces a flexible fee management system driven by hooks. Fees can be either static (predefined at pool creation) or dynamically adjusted by the hook contract. Hook contracts also possess the ability to allocate accrued fees among various stakeholders, including liquidity providers, swappers, and protocol creators.

3.1.1 Features of Hook-based Fee Management:

- **Static and Dynamic Fee Structures:** Pool creators can define static fees or rely on hooks to adjust fees dynamically based on predefined algorithms.

easier upgrades at the pool level. Pools are created via a **Factory Contract**, ensuring consistency and minimizing gas costs for deployment.

- **Pool Contracts:** Store the state and manage operations specific to each token pair.
- **Factory Contract:** Creates and registers pool contracts while ensuring no duplicate pools are deployed for the same token pair and fee tier.

5.2 Centralized Pool Management

URswap employs a **Pool Manager Contract** to act as a central interface for users. This contract coordinates operations across pools and provides a unified API for:

- **Multi-hop swaps:** Aggregates routes across pools.
- **Liquidity management:** Simplifies adding and removing liquidity by interacting with multiple pools.
- **Flash loan and advanced operations:** Executes compound operations efficiently.

5.3 Flash Accounting

Flash accounting ensures gas efficiency and security during operations by maintaining internal deltas (net balances) during each transaction and settling them only at the end.

- **Transient Storage:** Implemented via **EIP-1153**, flash accounting uses transient storage for intermediate calculations, avoiding unnecessary gas costs associated with storage writes.

- **Final Settlement:** External token transfers occur only once, after all operations in the transaction are processed.

5.4 Efficiency in Multi-Pool Transactions

Although each pool has its own contract, URswap's architecture minimizes gas costs for multi-pool swaps through:

- **Optimized Routing:** The Pool Manager determines the most efficient path for multi-hop trades across pools.
- **Batch Processing:** Operations like swapping and liquidity provision can be executed in a single batched transaction, reducing the number of on-chain calls.

5.5 Flexible Pool Customization

The separate pool contracts allow for unique configurations, including:

- Variable fee tiers for different pools.
- Customized hooks for advanced features.
- Integration with advanced AMM algorithms or external oracles for specific pools.

5.6 Future-Proofing and Upgradability

URswap achieves modularity by maintaining separate contracts for each pool and centralizing operations in a Pool Manager. This structure simplifies upgrades to individual pools or the manager contract without disrupting the entire ecosystem.

6. Cross-Chain Bridges

In an increasingly interconnected blockchain ecosystem, **URswap** enables smooth asset

transfers and interactions across multiple blockchain networks through its innovative **Cross-Chain Bridge Infrastructure**. This feature positions URswap as a truly multi-chain decentralized exchange, breaking down silos and enhancing liquidity flow between chains.

6.1 Bridging Infrastructure

The URswap Cross-Chain Bridges are powered by a combination of smart contracts, relayers, and oracles to ensure secure and efficient transfers. Key components include:

- **Lock-and-Mint Mechanism:** Assets are locked on the source chain, and a corresponding wrapped token is minted on the target chain.
- **Burn-and-Release Mechanism:** When tokens are transferred back, wrapped tokens are burned on the target chain, and the original tokens are released on the source chain.
- **Relayer Nodes:** Decentralized relayers validate transactions and facilitate communication between chains, ensuring trustless operations.
- **Oracles:** Oracles provide real-time data to verify the state of assets on the source chain before executing operations on the target chain.

6.2 Supported Chains

URswap's Cross-Chain Bridges initially support leading blockchains like:

- Binance Smart Chain
- Ethereum
- Polygon
- Avalanche

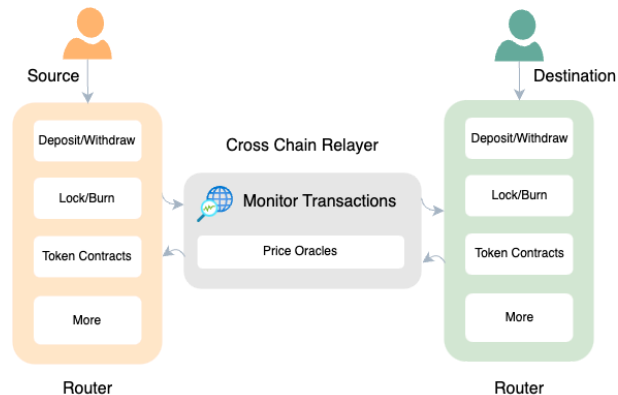
- Optimism and Arbitrum (for Layer 2 solutions)

More chains can be integrated based on community demand and ecosystem growth.

6.3 User Workflow

The user-friendly bridge interface ensures a seamless cross-chain experience:

1. **Select Source and Target Chains:** The user chooses the blockchain networks for the transfer.
2. **Deposit Assets:** The assets are deposited into a secure smart contract on the source chain.
3. **Asset Minting:** Equivalent wrapped tokens are minted on the target chain and transferred to the user's wallet.
4. **Reverse Transfer:** When the user transfers assets back, the wrapped tokens are burned, and the original assets are unlocked.



6.4 Security and Reliability

URswap employs a multi-layered security architecture to safeguard cross-chain operations:

- **Multi-Signature Validation:** Relayers operate under a multi-signature consensus model to prevent single points of failure.
- **Fraud Detection:** Real-time monitoring systems flag suspicious activity and halt transfers if anomalies are detected.
- **Audited Smart Contracts:** All bridge contracts undergo rigorous third-party audits to ensure reliability..

6.5 Liquidity Flow Across Chains

URswap bridges empower liquidity providers to optimize returns across multiple chains by:

- Facilitating liquidity transfers to capitalize on arbitrage opportunities.
- Enabling cross-chain yield farming and staking for increased earning potential.

6.6 Future Enhancements

URswap plans to expand its cross-chain ecosystem with:

- **Composable dApps:** Allow developers to build cross-chain decentralized applications (dApps) leveraging URswap's bridge APIs.
- **Interoperability Standards:** Support for emerging standards like **IBC**(Inter-Blockchain Communication) to connect with Cosmos and other ecosystems.
- **Cross-Chain Governance:** Enable URswap token holders to participate in governance decisions spanning multiple chains.

Summary

URswap is a next-generation AMM on Binance Smart Chain, bringing a modular, user-centric ecosystem. Advanced features such as customizable hooks, gas optimization, and cross-chain bridges enhance flexibility, scalability, and sustainability. Innovative use cases are supported by architecture and strong security, enabling seamless multi-chain operations. URswap is a future-proof solution in the making that will redefine the decentralized finance market by providing reliable, adaptable, and cost-effective trading.