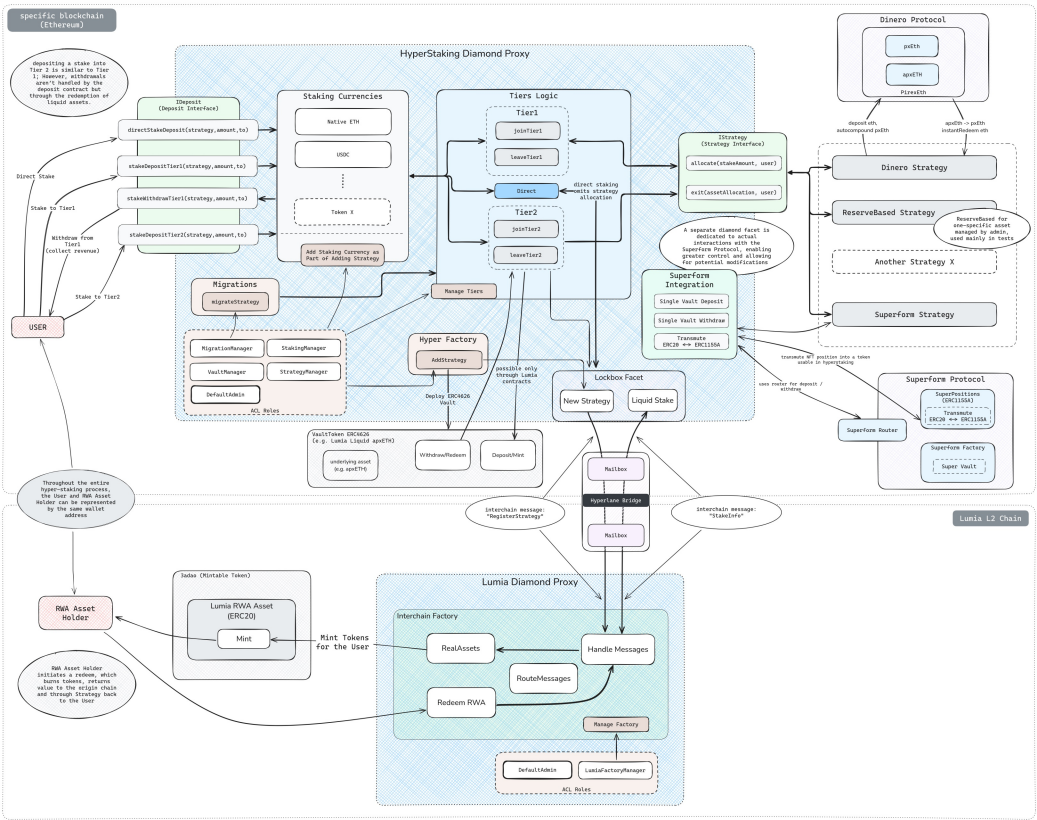


# Lumia Smart Contracts

This specification describes the architecture and key features of the Lumia Smart Contracts, which manage staking pools, cross-chain asset handling, and contract upgrades. The system uses two or more Diamond Proxy contracts: one on the origin chain (such as Ethereum or Arbitrum) to manage deposits and revenue strategies, and another on the Lumia Chain to handle interchain communication, RWA asset generation, and revenue distribution.



## o. Diamond Proxy Architecture

Lumia smart contracts is developed using the [Diamond Proxy pattern](#):

- **Modularity and Upgradeability:** The architecture supports adding or replacing functionalities without affecting ongoing operations, ensuring flexible contract modularity.
- **Second Diamond Proxy on Lumia Chain:** The secondary Diamond Proxy operates on the Lumia Chain to manage cross-chain asset handling, effectively functioning as a bridge. It facilitates Hyperlane interchain messaging and ensures that liquid RWA tokens accurately represent real value.

## Access Control List (ACL)

The **Access Control List (ACL)** defines roles like `StakingManager`, and `VaultManager`, each with specific permissions to manage different parts of the protocol. The **DefaultAdmin** role holds the authority to assign and revoke these roles, ensuring controlled access to critical functions. Additionally, the **DefaultAdmin** role is also responsible for managing **proxy upgrades**, allowing it to add, replace and delete specific contracts functionality.

## Hyperlane Integration

**Hyperlane** plays a crucial role in facilitating cross-chain communication and managing **RWA Assets** within **HyperStaking**. The integration is based on a **two-tier** system that supports both traditional and liquid staking operations, as well as **direct staking**, which most closely resembles a bridge operation:

- **directStaking:** Direct staking allows users to stake assets directly on the Lumia Chain without needing to pass through the revenue strategy. This enables faster processing and more flexible staking options, while still maintaining cross-chain compatibility through Hyperlane's messaging infrastructure.
- **Tier 1:** The primary tier, typically deployed on a chain like Ethereum, maintains the base infrastructure for traditional staking. Users stake assets, and their staking information is stored in contract storage along with their share in associated strategies. While no liquid tokens are issued in this tier, a small revenue fee is collected to benefit Tier 2 operations, incentivizing cross-chain functionality.
- **Tier 2:** Deployed on the Lumia Chain, this tier manages liquid staking. When users stake assets, an interchain message is sent to mint a liquid RWA Asset on the Lumia Chain, representing the revenue-generating assets linked to the strategy. These tokens are fully transferable, tradeable, and can be redeemed back to the originating chain. This architecture enables the Lumia Chain to collect revenue from assets on origin chains. The Tier 2 system ensures efficient interchain messaging, leveraging Hyperlane's robust bridging capabilities.

Through this setup, users benefit from multi-chain revenue streams without the complexity of interacting with multiple protocols and bridges directly.

## 1. Handling Multiple Deposit Currencies

The Lumia protocol supports staking with both native assets (e.g., ETH) and ERC-20 tokens. In some cases, even NFTs are indirectly supported through certain strategies (e.g., **Superform**). This allows for flexible staking operations across different asset types.

- **Native and ERC-20 Tokens:** The protocol distinguishes between native chain coins (such as ETH) and ERC-20 tokens using the `Currency` struct:

```
/**
 * The Currency struct represents a token
 * If `token` is address(0), it represents native coins (e.g. ETH)
 * @param token Address of the token, address(0) means native chain coin (e.g. ETH)
 */
struct Currency {
    address token;
}
```

- **Strategy Flexibility:** Each strategy can support different types of assets, including both native and tokenized assets. Strategies like **Superform** can even support NFTs indirectly by wrapping them in a compatible format.
- **Unified Management:** Despite supporting various asset types, the system maintains a unified interface for deposits, ensuring consistent behavior across different strategies and asset classes.

## 2. Revenue Strategies

Low-risk strategies are used to generate optimal income for stakers. All strategies implement a common interface, enabling seamless integration with staking pools and allowing new strategies to be added over time. The interface is defined in the [IStrategy.sol](#) contract and includes the following key functions:

```
/**
 * @notice Allocates a specified amount of the stake to the strategy
 * @param stakeAmount_ The amount of stake received for allocation
 * @param user_ The address of the user making the allocation
 * @return allocation The amount successfully allocated
 */
function allocate(
    uint256 stakeAmount_,
    address user_
) external payable returns (uint256 allocation);

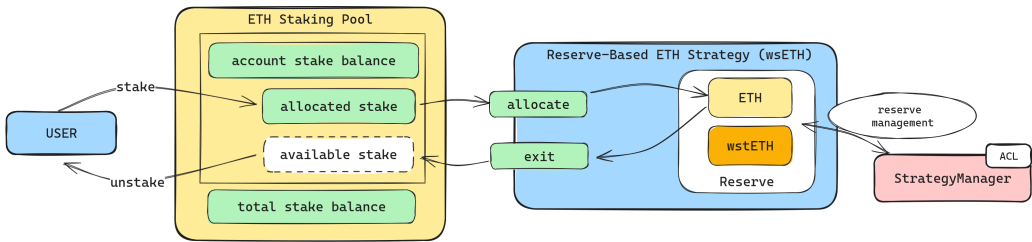
/**
 * @notice Exits a specified amount of the strategy shares to the vault
 * @param assetAllocation_ The amount of the strategy-specific asset (shares) to withdraw
 * @param user_ The address of the user requesting the exit
 * @return exitAmount The amount successfully exited
 */
function exit(uint256 assetAllocation_, address user_) external returns (uint256 exitAmount);
```

This interface allows strategies to be deployed independently of the main upgradeable Proxy Diamond code and linked with new staking pools.

- **Shares:** Are emitted by the strategies and moved to the `StrategyVault`. These shares represent the user's contribution in the strategy, (vault may potentially issue derivative tradable liquidity tokens). Specific strategies examples are detailed below.

## Example Strategy: Reserve-Based Strategy

One example of a strategy is a **reserve-based strategy** focused on yield generation through a specific defined asset (e.g., stETH from the Lido Protocol). This reserve is managed to ensure sufficient liquidity for staking and unstaking operations. When users stake ETH, the strategy allocates a portion of the available wstETH from the reserve to the user, allowing them to benefit from staking rewards generated by Lido.



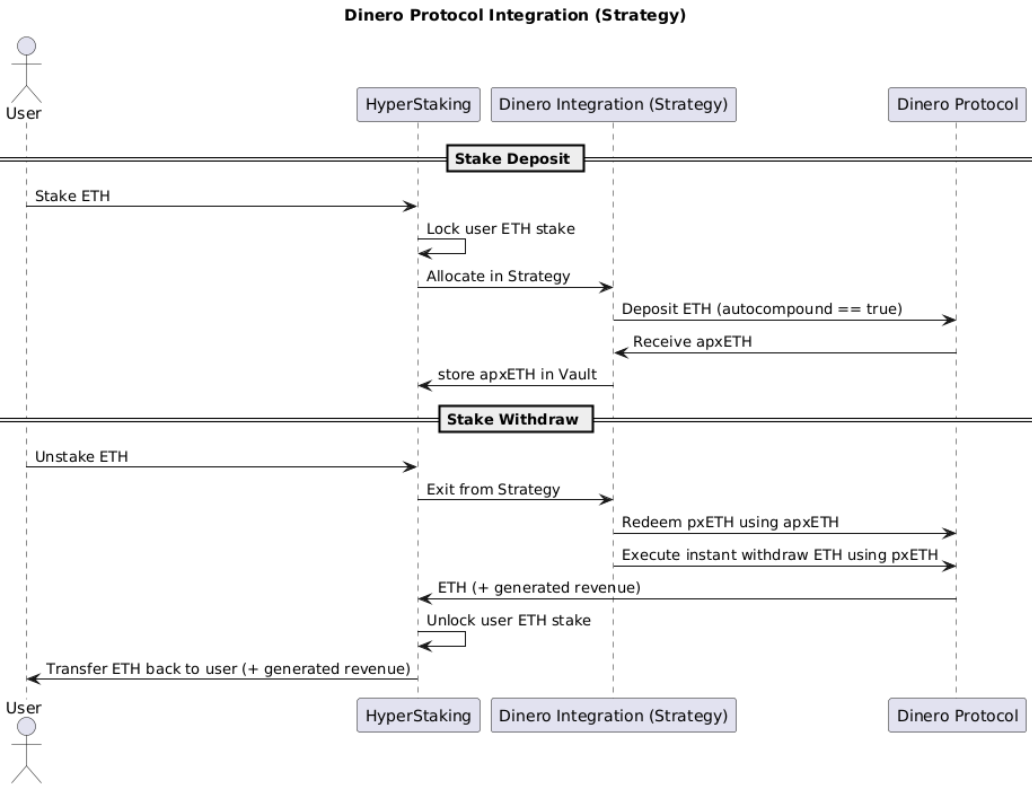
When users exit, the strategy returns their initial ETH plus the generated income, ensuring smooth exits without needing to interact with external protocols for each individual transaction. This approach minimizes transaction costs and optimizes the use of liquidity within the pool.

However, this solution has its limitations. It's possible that the strategy may not have full ETH coverage at certain times. In such cases, the user will still be able to perform a partial unstake. Additionally, the user will not lose any accrued revenue, as it is tracked within the contract, allowing them to claim their rewards once the reserve is replenished.

A simplified version of this strategy has been implemented and is currently being used for testing purposes.

## Example Strategy: Dinero Protocol Integration

Another example strategy is the **Dinero Protocol Integration**, focused on yield generation through the **apxETH** token, emitted by the **PirexETH** contract from the Dinero Protocol. The strategy auto-compounds pxETH into apxETH to maximize returns, generating around 8% APY, and is stored in the Lumia **StrategyVault**.



When users stake ETH, the strategy interacts directly with the Dinero Protocol, converting ETH into pxETH, which is then auto-compounded into apxETH. This allows users to benefit from the compounding returns offered by the Dinero Protocol.

When users unstake, the Dinero Protocol is used to redeem pxETH from apxETH (an ERC-4626 vault). pxETH is then converted to ETH for withdrawal, plus accumulated interest, with a 0.5% fee applied.

In the future, the fee could be reduced by implementing a delayed unstake option, creating an unstake buffer for ongoing operations, similar to the model used in the Dinero Protocol.

### 3. Migrations

The Lumia protocol supports seamless strategy migrations to enable upgrades and rebalancing without disrupting staking operations. Underlying assets can be migrated between strategies while preserving user positions and ensuring that the staked currency remains consistent.

#### Migration Process

- **Direct and Yield Strategy Migration:** The protocol supports migrating both direct-staking and yield-bearing strategies. Direct strategy migration transfers assets without minting new RWA tokens, while yield strategy migration withdraws assets from the source strategy and deposits them into the target strategy.
- **Currency Consistency:** Both the source and target strategies must use the same stake currency. If the currencies do not match, the migration is rejected.
- **Cross-Chain Synchronization:** Migration data is forwarded across chains, ensuring that cross-chain state remains consistent and that assets are correctly accounted for.
- **Governance and Access Control:** Migrations are restricted to the **Migration Manager** role, which can be transferred to a DAO through governance. This ensures that migrations remain secure and transparent under decentralized control.