Staking on Ethereum: A Comprehensive Guide

Key Features

Blockchain Overview

Ethereum, since its mainnet launch in July 2015, has been pivotal in pioneering blockchain technology, being one of the earliest to transition from Proof of Work (PoW) to Proof of Stake (PoS). It stands out for its robust smart contracts and decentralized applications (dApps), fostering a flourishing DeFi ecosystem. The platform's versatility is enhanced by the Ethereum Virtual Machine (EVM) and its native asset, ETH, which coexists with a vast array of tokens and NFTs. To address scalability, Ethereum employs Layer 2 (L2) technologies, ensuring it remains a cornerstone in the blockchain domain.

Block Time and Fee Structure

- Block time: 12 seconds, also referred to as slots, with epochs comprising 32 slots.
- 1 epoch = 32 blocks = 6.4 minutes (fixed)
- Fee structure: Priority fees are chosen by users and are paid to validators, while base fees are defined by the protocol and are burned.

Staking Overview

Minimum Stake to Initiate a Validator

32 ETH to 2048 ETH enabling in-protocol autompounding

Warm-up/Bonding Periods

- Validators must join an activation queue, with variable length dependent on the number of validators waiting to join the active set. The entry churn rate is fixed at 8 validators per epoch.
- Queue information available at https://www.validatorqueue.com/

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Staking Overview [Cont.]

Cool-down/Unbonding Periods

- Validators initiate a voluntary exit request.
- Join an exit queue, which varies based on the number of validators waiting to exit. The exit churn rate is variable depending on the size of the active set.
- Once at the front of the queue, validators wait for an additional 256 epochs (~27.3 hours) before ETH can be withdrawn.
- Withdrawal times can vary, but it may take up to 10 days.
- Queue information available at https://www.validatorqueue.com/

Rewards Overview

Reward Structure Highlights

- Rewards are calculated and distributed on an epoch basis.
- There are five types of rewards: attestation (every epoch), proposer (when selected to propose a block), sync committee (when selected to be in the Sync Committee), plus MEV and transaction fees (the priority fee contribution).
- Reward variability depends on factors such as: the number of validators, luck, network activity impacting MEV and transaction fees, and performance of the validator.

Payout Timing

- Validator balances update at the end of each epoch (approximately every 6.4 minutes) to account for rewards, penalties, and slashing.
- Rewards are automatically paid out to the fee recipient address of the validator approximately every 6/7 days.
- Rewards allow autocompounding, and the maximum stake per validator is 2048 ETH.
- Excess ETH is automatically withdrawn if a valid withdrawal address is provided.

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Rewards Overview [Cont.]

Compounding rewards: No

Expected APR: ~3.02% (2.74% on Consensus Layer and a further 0.25% for MEV and transaction fee-related rewards)

Slashing Overview

Slashing Possibility: Yes

Causes of Slashing

- Validator proposes more than one block for a slot or votes incorrectly
- Slashing and inactivity penalties are different, with penalties for missed slots or attestations roughly equal to missed rewards.

Additional Penalties

- In a unique and rare scenario where the network struggles to achieve finalization, validators may be penalized for being offline. This event is referred to as an Inactivity Leak.
- Active validators are less likely to incur significant penalties.

Note: Slashing is extremely rare on Ethereum.