LINEA SEPOLIA

- Based on L2 zkEVM (zero-knowledge Ethereum Virtual Machine)

L2 Scaling

Layer 2 solutions are designed to handle transactions off the main blockchain, thus reducing the load on the L1 blockchain while still benefiting from its security enabling faster and cheaper transactions. [1]

Benefits: [2]

1. Higher transaction throughput: By processing transactions offchain, L2 solutions can handle a significantly higher number of transactions per second compared to the main chain.
2. Reduced transaction costs: L2 solutions minimize the gas fees associated with onchain transactions, making it more cost-effective for users to interact with the L1.
3. Faster transaction finality: Offchain transactions can achieve near-instant finality, providing a better user experience and enabling real-time applications.
4. Improved privacy: Some L2 solutions, such as **state channels**, offer increased privacy by keeping transaction details offchain and only settling the final state on the main chain.

Limitations:

1. Increased complexity: Implementing and integrating L2 solutions can introduce additional complexity to the blockchain ecosystem, requiring specialized knowledge and tools.
2. Security trade-offs: While L2 solutions inherit the security of the main chain to a certain extent, some might introduce new attack vectors or trust assumptions that need to be carefully considered.
3. Liquidity fragmentation: The presence of multiple L2 solutions can lead to fragmentation of liquidity, as assets are spread across different networks and require bridging mechanisms to move between them.
4. Dependency on L1: L2 solutions still rely on the main chain for settlement and security, meaning any issues or congestion on the main chain can impact the performance of L2 networks.

What are State channels?

1. Opening the Channel: Two or more participants initiate a state channel by locking up a certain amount of cryptocurrency in a multi-signature smart contract on the main blockchain (e.g., Ethereum). This step is recorded on-chain and serves as the starting point for the off-chain transactions.
2. Off-Chain Transactions: Once the channel is open, the participants can exchange an unlimited number of transactions off-chain. These transactions are instant, free from the blockchain's usual delays, and not visible to the public. Since they occur off-chain, they are not subject to the main blockchain's fees or confirmation times.
3. Closing the Channel: At any point, the participants can close the state channel. When they decide to do so, they submit the final state of the channel to the blockchain. The smart contract then releases the funds according to the final balance, which reflects all the off-chain transactions.
4. Dispute Resolution: If a dispute arises, any participant can submit the most recent signed transaction to the blockchain, which can enforce the correct distribution of funds based on that transaction.

Users have to create and pay for an Ethereum transaction when they first open up the channel. When they're ready to close the channel, they again have to pay fees to process a transaction on the Ethereum blockchain

Zero Knowledge Proofs

On Ethereum, every transaction must be verified by every node. In contrast, zero-knowledge rollups are a layer-2 scaling solution that "roll up" a large batch of transactions and verify their correctness with a ZKP published on a layer-1 blockchain like Ethereum. This increases throughput and reduces costs while maintaining security [3]

1. https://www.starknet.io/blog/layer-2-scaling-solutions/#:~:text=L2%20solutions%20process%20transactions%20off,such%20as%20Bitcoin%20and%20Ethereum.
2. https://www.starknet.io/blog/layer-2-scaling-solutions/#benefits-and-limitations
3. https://chain.link/education-hub/zkevm