Web3 Solana Blockchain - 01

Solana is a fast, cheap, and scalable Layer 1 blockchain, gaining rapid growth in the web3 ecosystem. It underpins financial systems, NFT trading, and play-to-earn games. It is fast, cheap, and a fast growing ecosystem within Web3. It also has a unique proof-of-stake algorithm that allows for faster transaction speeds and lower fees. Solana offers fast, scalable, and cheap transactions. SOL has a block time of 400 milliseconds, which means the Solana network is very fast at confirming transactions. Just to give you an idea of how fast Solana is, Ethereum's block time is 10 seconds and Bitcoin's is 10 minutes. It is also able to handle more transactions per second than Visa. Solana can handle 710,000 transactions per second, whereas Visa can only handle 23,666 transactions per second. And finally, Solana's transaction fees are very cheap, coming in at one hundredth of a penny.

Proof-of-History

Proof-of-History (PoH) is derived from Proof-of-Stake (PoS) and can be considered the eight inventions of Solana. It focuses on the concept that instead of trusting timestamps given on a block, you could prove that a message occurred at a specific time before and after an action. In distributed networks, agreeing on the time and sequence in which events happened is a challenge, because nodes in a network can't simply assume that an external source of time or timestamp appears in a message and is truthful. However, Solana's Proof-of-History protocol makes it possible to create a historical record that proves an event that happened at a specific moment in time.

Proof-of-History is a high Verifiable Delay Function (VDF). Solana requires validators to solve these VDFs continuously. A VDF requires a specific number of sequence steps to evaluate but also produces a unique output that can be efficiently and publicly verified. VDFs can only be solved by a single CPU core applying a particular set of sequential steps.

Tower BFT

Solana runs a Tower Byzantine Fault Tolerance (BFT) consensus mechanism on their Proof-of-History protocol. Tower BFT leverages the PoH as a clock before consensus to reduce communication overhead and latency. In many aspects, this consensus is similar to the Practical Byzantine Fault Tolerance consensus algorithm PBFT. However, unlike PBFT, Tower Consensus prefers liveness over consistency. In this system, nodes exponentially increase their timeouts to agree. But since the ledger is also a trustless source of time, nodes can observe and examine timeouts of all validators in the network.

Turbine

The Solana consensus layer has no dependence on peer-to-peer messages, which makes it possible to optimize the way blocks are transmitted through the network independently. Turbine is a block-propagation technique. In a distributed system, increasing the node count will directly increase the amount of time necessary to send all the data to all nodes. Turbine is created to solve that issue. In this case, when a node produces a message to 500 of its peers, it wouldn't need to transmit the information 500 times. Instead, the message is broken down and sent in a packet to a different validator. Each validator retransmits the packet to a group of peers.

Sealevel

Sealevel is a hyper-parallelized transaction processing engine designed to scale horizontally across graphics processing units (GPUs) and Solid State Drives (SSDs). With this, it is essential to keep in mind that all other blockchains are single-threaded computers. Solana is the only chain to support parallel transaction execution in a single shard.

Gulf Stream

Gulf Stream works by pushing transaction caching and forwarding to the edge of the network. In Solana's network during each block production process, the upcoming network leaders will be determined according to their stake. Since every validator, therefore, knows the order of the forthcoming leaders in the architecture, clients, and validators forward transactions to that expected leader ahead of time. That, in turn, allows validators to execute their transactions ahead of time, reduce confirmation times, and switch leaders faster. Moreover, it reduces the memory pressure on validators from the unconfirmed transaction pool.

Cloudbreak

Cloudbreak was designed as a state architecture that's optimized for concurrent reads and writes spread across a RAID 0 configuration of SSDs. Coupled with Solana's transaction design, this architecture supports Ahead Of Time (AOT) execution of transactions. By combining Sealevel with Cloudbreak, validators can start executing transactions before they are even encoded into a block; this allows for further optimization of the block time and confirmation of latencies.

Archivers

On the Solana Network, data storage is offloaded from validators to a network of nodes named the Archivers. These Archivers aren't a part of the consensus. The history of the state is distributed into many different pieces and coded. Archivers store small parts of the state, and from time-to-time, the network will ask the Archivers to prove that they're holding the data.

Pipeline

The pipeline is a Transaction Processing Unit for validation optimization. On the Solana Network, the process of transaction validation makes extensive use of an optimization that is also common in CPU design, called pipelining.

Why Solana?

This is the cool part — Solana is engineered for widespread, mainstream use by being energy efficient, lightning fast, and extremely inexpensive.

Many of the core Solana builders, like co-founder Anatoly Yakavenko, have a background in building cell phone networks. That means that they are singularly focused on building for scalability (the ability to grow) and efficiency (the ability to get the most information across with the least amount of resources). They believe that in order for people to build the projects that will get the public using blockchain technology, you need to make it as easy and painless as possible for people to experiment and use the technology as possible.

Some of the current leading blockchain technologies use energy-hogging, time-consuming mining — or solving very complex calculations — to validate security, and have fees that can range into the hundreds of dollars per transaction. Solana uses what's called *proof of stake* to validate information — there's no mining involved — and a special innovation called proof of history on top of that that allows it to validate even quicker. That makes it extremely efficient, using energy at the same scale as a few Google searches and significantly less energy than other regular household uses like running your refrigerator. Transaction fees, which are used to maintain blockchain networks and have ballooned elsewhere, are a fraction of a cent on Solana.

All of that translates into projects and tools built on Solana that can be as frictionless and easy to use as the rest of the internet, for both developers and users.

Solana White Paper