Running a Solana Validator: a full breakdown

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“Based on what I have been learning, a new validator can become profitable in about 10 to 20 epochs if everything is done correctly, without needing stake from the Foundation.” — SolDev

Solana’s decentralization is a hotly debated topic.

The hardware and bandwidth requirements to run a node are often weaponized to portray Solana as permissioned or centralized.

There’s also some vagueness around what it would take to run a validator and how profitable it would be.

This article intends to provide some clarity by shedding light on the intricacies of running a Solana validator.

By the end of it, you’ll understand:

1. what a validator is and what it does
2. the economics of, benefits and challenges associated with running your own validator
3. the short-, mid-and long-term realities of running a validator

While I won’t detail the process of getting a validator online, I will link resources for those interested.

This article assumes an intermediate level of understanding of blockchain concepts, especially consensus and Proof-of-Stake. If you’d like to start from there, you can find that here

Outline

Terminology

Before we get started, a few terms will come up periodically, so let’s get them out of the way:

- Node: A computer running the blockchain program.
- Fork: A version of a blockchain that isn’t the main chain yet..
- Slot: the period of time where one block is produced. It can also be called block time.
- Epoch: A block of 432,000 consecutive slots. Not any 432,000 slots, rather distinct blocks of 432,000 slots.
- Epoch-year: The number of epochs in 365 days (calculated with a 400 ms slot time). Exactly 182.5
- Leader: The validator

that’s producing the block for that slot

- Client: A client is a version of the blockchain's program. The base client is the original program. Other clients could be implementing the same functionality in a different language or altering some features to achieve the same result.

With that out of the way, let's dive in.

What is a validator, and what does it do?

A validator is PoS terminology for a node that participates in blockchain consensus.

In PoS, voting nodes put up tokens as collateral that can be seized or destroyed should they behave maliciously.

Voting nodes are tasked with:

1. Creating blocks when they are the leader.
2. Verifying and voting for or against blocks when they are not the leader.

Validators are crucial to the network because they effectively decide what is true. The greater the number of validators, the more secure and decentralized the network is. Stake spread is also very important. But all of this is likely not news to you.

Let's move on to why we're here.

Running a Validator

Before we move forward, it's important we make a distinction between validators and RPC nodes on Solana.

In an ideal world, everyone who uses the blockchain would run their own node. These nodes would connect to other nodes to propagate the user's transactions and verify that the blockchain is true.

In practice, this doesn't happen because of how technically and financially demanding it is to run a node. For most people, RPC nodes are how we interact with the blockchain.

An RPC node does two things:

1. It checks that the forks being voted for are true
2. Because an RPC node is connected to other blockchain nodes (including validators), it can submit transactions for processing and provide data about the state of the blockchain. Every time you've used a blockchain, you've likely used an RPC node.

This article will focus mainly on validators because the economics of operating an RPC node are obscure.

dApps (like wallets) either run their own RPC nodes or pay entities likeHelius to use RPC nodes. But these arrangements are done off-chain.

We can see Helius' pricing here, but we have almost no idea about the operational costs or demand. So it's hard to say how much profit (or loss) RPC providers make.

Because of this, we'll focus exclusively on Validators going forward.

For those interested in running RPC nodes, the Solana Tech discord linked at the end of this hosts ann RPC node operator channel. You can ask more questions there.

So, what do you need to run a validator?

A validator operator's main job (after completing the setup) is to monitor their node and work on improving its performance.

There are two primary things a validator needs:

1. Technical expertise and,
2. Money.

Everything else is secondary.

Technical expertise is crucial because, as you'll soon see, running a validator is technically demanding. You need to understand hardware, DevOps, blockchain architecture and backend development if you're going to be successful.

You can run a node without understanding these things, but you'll struggle with even the most "basic" things.

Here's someone who paid more than double what he should have for hardware but ended up struggling to get his node running because the setup just wasn't right.

You'll see more examples like this as we move on, have it in the back of your mind that running a node is technically demanding.

Aside technical expertise, running a validator can be expensive.

Let's break down the requirements.

Node Requirements

To run a validator, you need four things: hardware, bandwidth, stake and voting SOL

Hardware and Bandwidth

These are the official recommendations from theSolana Labs documentation:

Bandwidth

: 1 GBit/s symmetric, commercial. 10 GBit/s preferred.

In practice, most validators run slightly more powerful machines but there are no benefits to going overboard.

Stake

There's no minimum stake on Solana and the network supports native delegation so validators don't need to (and usually don't) own all the SOL they stake.

But the more you stake, the more likely you're selected as leader

. The exact amounts you should aim for will be discussed in the economics section.

Voting SOL

On Solana, votes count as transactions, and a validator is expected to vote on every block. It comes out to around 1 SOL per day but we'll discuss all the nuance in the economics section.