# Understanding Ethereum Node Architecture

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Published in Novai-Blockchain 101

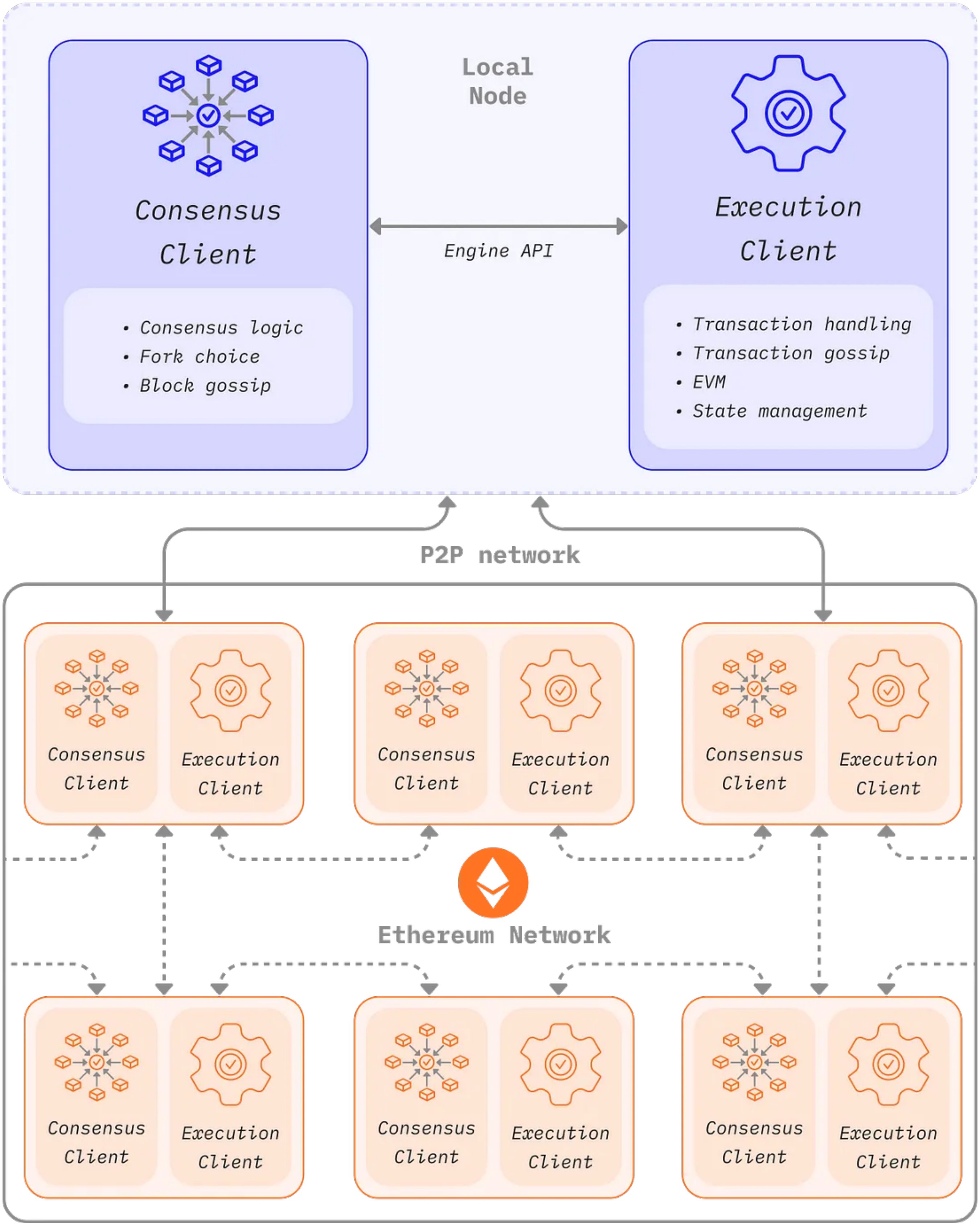
3 min read · May 7, 2024



Ethereum, the groundbreaking blockchain platform, operates through a complex network of nodes. These nodes play crucial roles in executing transactions, reaching consensus, and ensuring the integrity of the Ethereum blockchain. Let's delve into the architecture of an Ethereum node to comprehend its inner workings.

### The Two Components of an Ethereum Node

An Ethereum node consists of two essential components: an execution client and a consensus client. In the past, when Ethereum operated on proof-of-work, only an execution client was necessary. However, with the transition to proof-of-stake, the execution client now collaborates with a consensus client.

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The diagram illustrates the relationship between these two clients. Each connects to its respective peer-to-peer (P2P) network. While execution clients handle transaction gossiping and local transaction pools, consensus clients manage block gossiping and facilitate consensus and chain growth.

### The Role of the Execution Client

The execution client takes charge of transaction handling, gossiping, state management, and supporting the Ethereum Virtual Machine (EVM). It generates execution payloads, comprising transactions and updated state data, which are included in every block by consensus clients. *Additionally, the execution client ensures the validity of transactions by executing them locally on the EVM.*

Moreover, it provides a user interface to interact with Ethereum through RPC methods, facilitating blockchain queries, transaction submissions, and smart contract deployments. Popular libraries like Web3js or user interfaces like browser wallets often handle RPC calls.

In summary, the execution client serves as:

- A user gateway to Ethereum.
- The home of the Ethereum Virtual Machine and transaction pool.

### The Functionality of the Consensus Client

The consensus client *handles the logic required for a node to synchronize with the Ethereum network*. It receives blocks from peers, runs fork choice algorithms, and *ensures nodes follow the chain with the highest accumulation of attestations.* Unlike the execution client, it doesn't participate in block proposing block and attestation, Attestation tasks are delegated to validators.

A validator attestation is a cryptographic proof provided by a validator in a blockchain network, confirming the validity of a particular block or set of transactions. In the context of Ethereum 2.0, validators play a crucial role in the proof-of-stake (PoS) consensus mechanism, where they are responsible for proposing and validating new blocks.

When a validator receives a block from the network, it verifies the transactions within the block and checks the validity of the block itself according to the consensus rules of the network. Once the validation process is complete and the validator is confident that the block is valid, it creates an attestation.

**COMPONENTS OF A NODE COMPARISON**

| Execution Client | Consensus Client | Validator |
|---|---|---|
| Gossips transactions over its p2p network | Gossips blocks and attestations over its p2p network | Proposes blocks |
| Executes/re-executes transactions | Runs the fork choice algorithm | Accrues rewards/penalties |
| Verifies incoming state changes | Keeps track of the head of the chain | Makes attestations |
| Manages state and receipts tries | Manages the Beacon state (contains consensus and execution info) | Requires 32 ETH to be staked |
| Creates execution payload | Keeps track of accumulated randomness in RANDAO | Can be slashed |
| Exposes JSON-RPC API for interacting with Ethereum | Keeps track of justification and finalization | |

Understanding the architecture of Ethereum nodes sheds light on the intricate processes that underpin this revolutionary blockchain platform. As Ethereum continues to evolve, so too will the architecture of its nodes, ensuring the scalability, security, and efficiency of the network.

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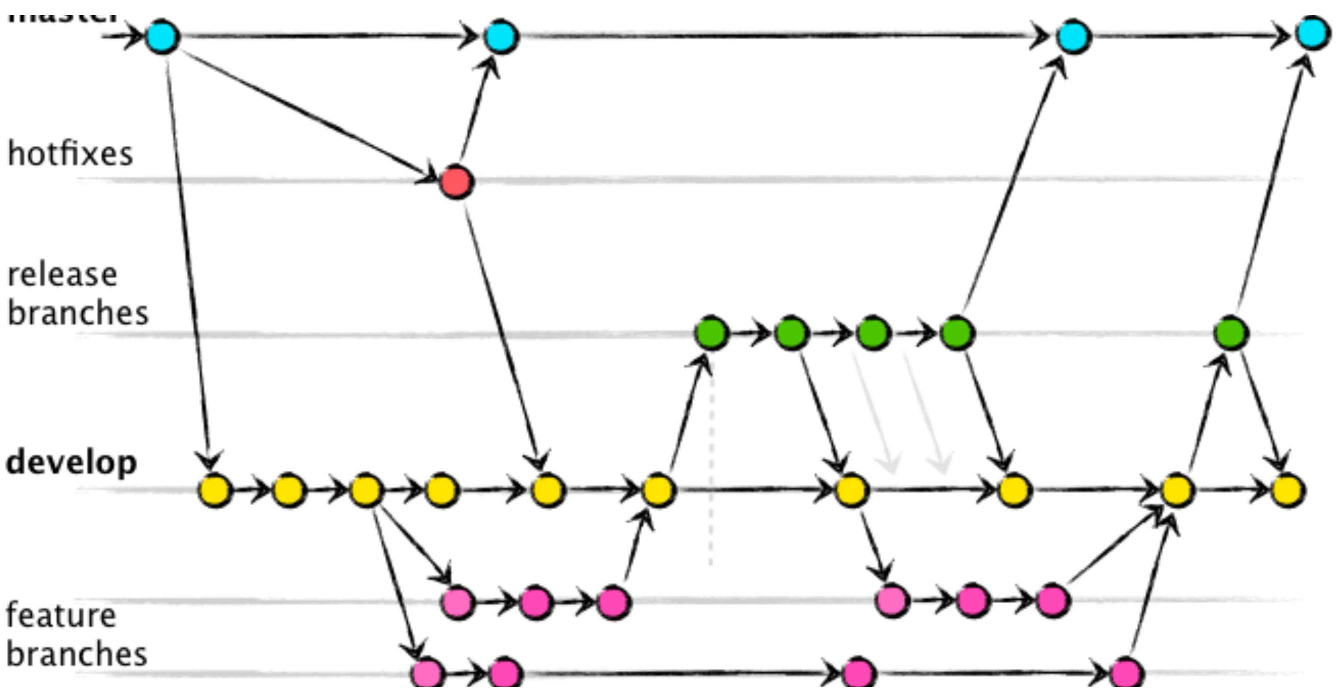


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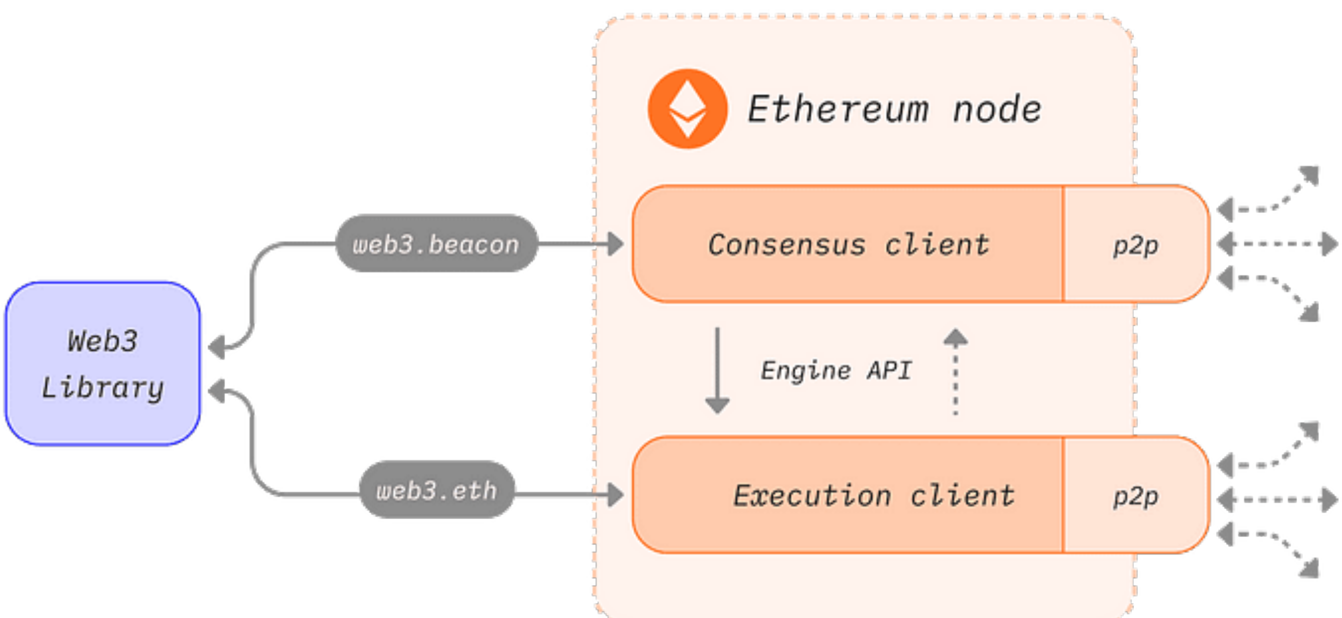

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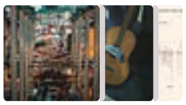

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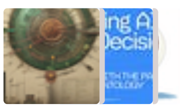

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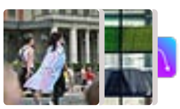

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```
const http = require('http');

const server = http.createServer((req, res) => {
    res.statusCode = 200;
    res.setHeader('Content-Type', 'text/plain');
    res.end('Hello, World!\n');
});

server.listen(3000, '127.0.0.1', () => {
    console.log('Server running at http://127.0.0.1:3000/');
```

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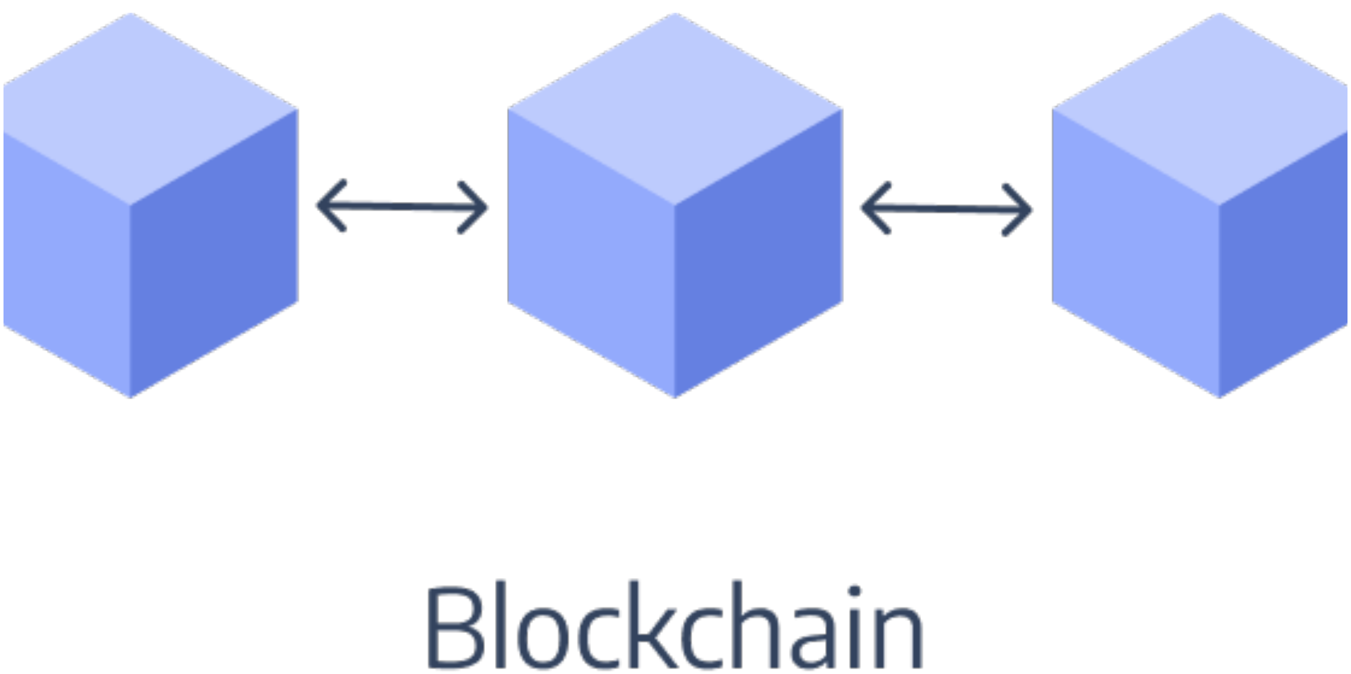

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