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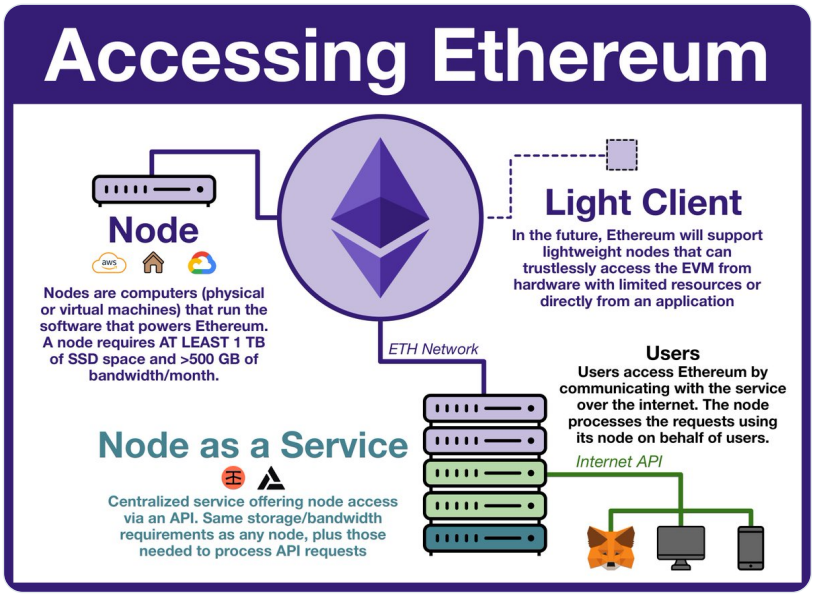
Nov 9 • 29 tweets • SalomonCrypto/status/1590137467524435971

(1/28) @Ethereum Basics: Accessing the World Computer

In order to access Ethereum, you need a node. But running a node is a big deal, it requires serious hardware, bandwidth and active maintenance.

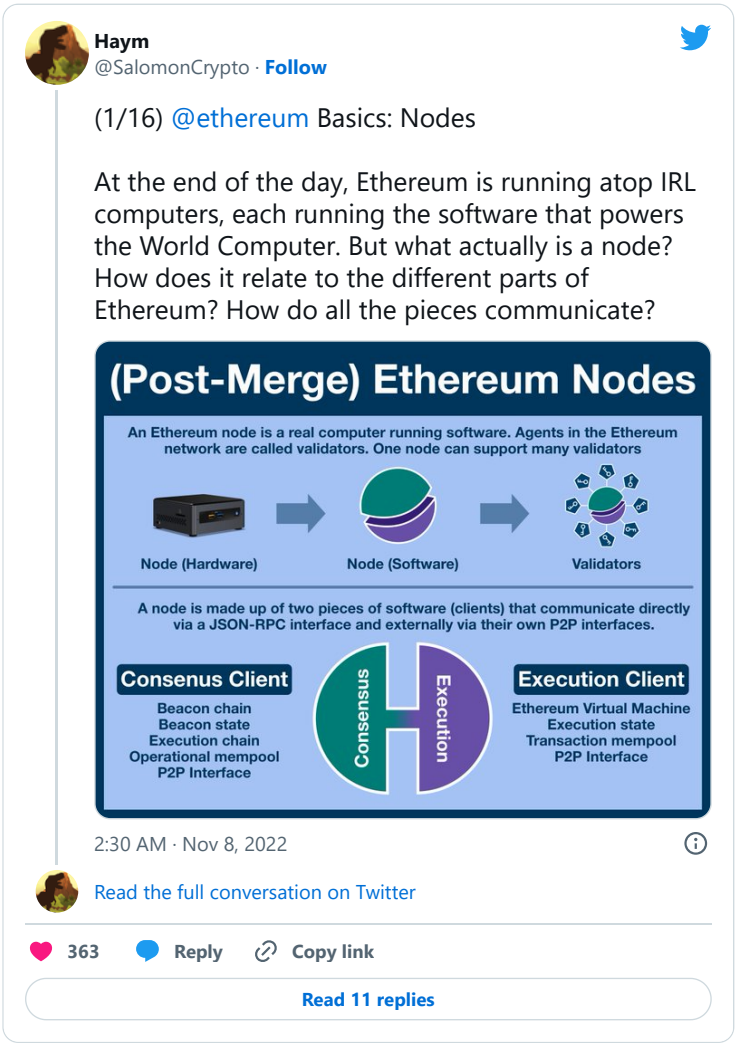
Today we have centralized solutions, but the future of Ethereum is trustless.



(2/28) @ethereum is the World Computer, a single, globally shared computing platform that exists in the space between a network of 1,000s of computers (nodes).

(3/28) You can think of a node in two ways: a real-world computer or the group of software needed to access, validate and otherwise run the World Computer.

Under the hood, a node is actually two independent pieces of software: a consensus client and an execution client.



(4/28) Think like this:

Consensus client: responsible for Proof of Stake (PoS), securing @ethereum with the value of $ETH

Execution client: responsible for operating the computing platform of the World Computer (the EVM).

These clients are HEAVY DUTY pieces of software.

(5/28) < NOTE >

Over the next few tweets I am going to walk you through the resource requirements of an @ethereum node in November 2022.

All the screenshots you see are real data pulls from the node I operate, so keep that in mind (for better or worse).

< /NOTE >

(6/28) First, let's look at the execution client (pictured here: @go_ethereum).

This is hard to digest, but the details aren't super important. The summary is ~425 GB to hold the EVM state and ~400 GB for historical data (although we can reduce this).

DATABASE	CATEGORY	SIZE	ITEMS
Key-Value store	Headers	49.25 MiB	90038
Key-Value store	Bodies	6.50 GiB	90038
Key-Value store	Receipt lists	5.33 GiB	90038
Key-Value store	Difficulties	10.11 MiB	119759
Key-Value store	Block number->hash	9.00 MiB	119568
Key-Value store	Block hash->number	622.72 MiB	15926161
Key-Value store	Transaction index	14.09 GiB	420137185
Key-Value store	Bloombit index	2.98 GiB	7966513
Key-Value store	Contract codes	4.54 GiB	729971
Key-Value store	Trie nodes	349.49 GiB	1940176772
Key-Value store	Trie preimages	547.13 KiB	8893
Key-Value store	Account snapshot	8.51 GiB	187028636
Key-Value store	Storage snapshot	59.87 GiB	837893492
Key-Value store	Beacon sync headers	0.00 B	0
Key-Value store	Clique snapshots	0.00 B	0
Key-Value store	Singleton metadata	7.78 MiB	16
Ancient store	Headers	7.11 GiB	15836124
Ancient store	Bodies	254.80 GiB	15836124
Ancient store	Receipt lists	121.45 GiB	15836124
Ancient store	Difficulties	249.75 MiB	15836124
Ancient store	Block number->hash	573.90 MiB	15836124
Light client	CHT trie nodes	0.00 B	0
Light client	Bloom trie nodes	0.00 B	0
	TOTAL	836.15 GIB	

(7/28) If you were to start a new node from scratch, your node would not have ~400 GBs of historical data; yours would be (effectively) 0 GBs.

Once online, your node begins communicating with the network and updating the EVM. The old data is moved into a historical database.

(8/28) (Most) historical databases grows by ~15GB/week; this will quickly grow out of control and overwhelm any non-data center node.

Fortunately, (most) execution clients can "prune" this database, discarding all historical records before the most recent snapshot.

(9/28) Now let's take a look at the consensus client (pictured here: @sigp_io).

Here things are a little simpler; you can see that (my specific instance of Lighthouse at this specific moment) is taking up 172 GB.

```
16K     /ethclient/lighthouse/beacon/network
51G     /ethclient/lighthouse/beacon/freezer_db
1.1G    /ethclient/lighthouse/beacon/logs
120G    /ethclient/lighthouse/beacon/chain_db
172G    /ethclient/lighthouse/beacon
172G    /ethclient/lighthouse
```

(10/28) There is a lot more we can do to bring this number down.

For starters, Lighthouse's db can be stored in as little as 15 GB (at the cost of performance).

Or you can switch to @ethnimbus which has been designed from first principles to be as lightweight as possible.

(11/28) Bottom line is there are a lot of configurations you can alter to change the storage size of your node, but no matter what it's going to be BIG (>500 GBs).

Here's what the @Rocket_Pool docs say.

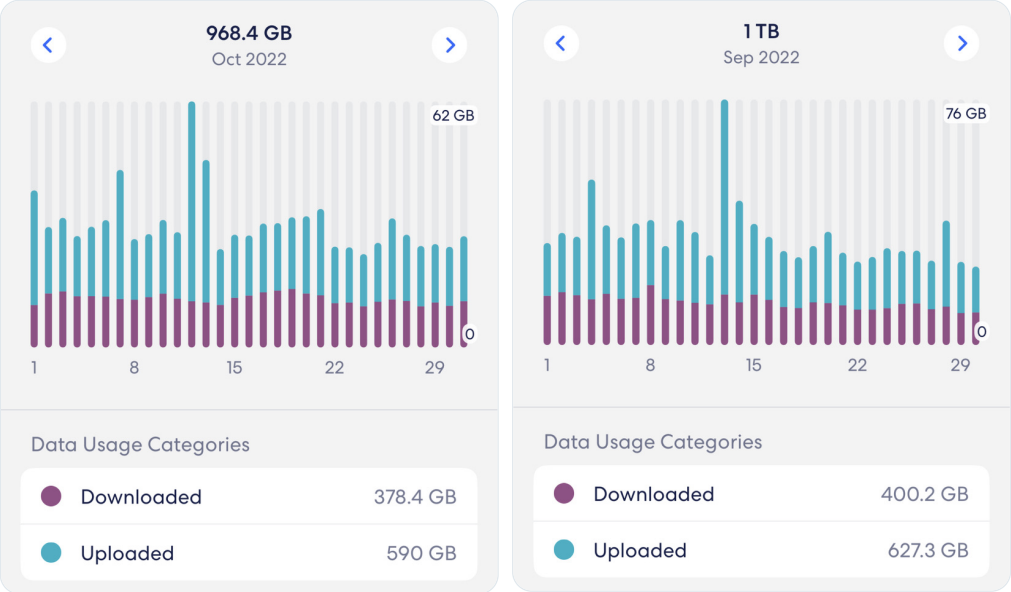
> The following are considered *minimum* requirements:
>
> - Linux or macOS Operating System
> - Quad core CPU (or dual-core hyperthreaded); both `x64` and `arm64` are supported
> - 8 GB of RAM (preferably DDR4)
> - 2 TB of free **SSD Disk Space** (*note: this only applies to mainnet; the Prater testnet only requires about 200 GB*)
>   - A spinning platter hard drive *is generally not fast enough* to handle the constant random reads and writes that blockchain activity requires; you MUST use a solid state drive.

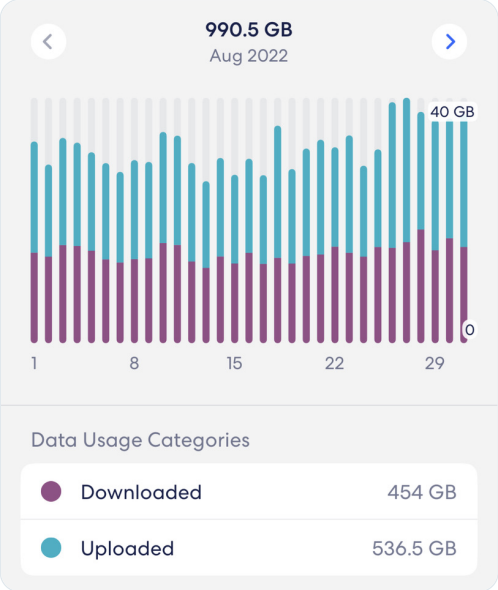
(12/28) You will also notice the CPU requirements. If "Quad core CPU (or dual-core hyperthreaded)" doesn't mean anything to you, you can just think "high end CPU made in the last 2-3 years."

Point is, a node requires a serious CPU.

(13/28) The hardware is not the only IRL resource required to run a node. You also need bandwidth. Lots and lots of bandwidth.

Right now, you're looking at something on the order of ~1 TB worth of bandwidth every month. That's ~13 GB download and ~20 GB upload every single day.





(14/28) We also need to consider the maintenance required to run a node. First and foremost, if a node is supporting one or more validators it MUST stay online 24/7; offline time is penalized by confiscating it's staked $ETH.

(15/28) But even if the node is not staking $ETH (merely acting as an access point into @ethereum, not a validator), maintenance is still critical.

If the node falls out of sync, it has to spend a significant amount of time catching back up (and a sync from scratch? 2+ days)

(16/28) Taken all together, running a node is a big deal. Don't get me wrong, it's totally doable and I highly encourage you all to look into it, but it is serious business.

Serious enough that many people interested in accessing @ethereum have no desire or ability to run one.

(17/28) Just to drive the point home, consider two examples:

Let's say Alice want's to access De-Fi, but doesn't have any experience operating software outside a consumer setting.

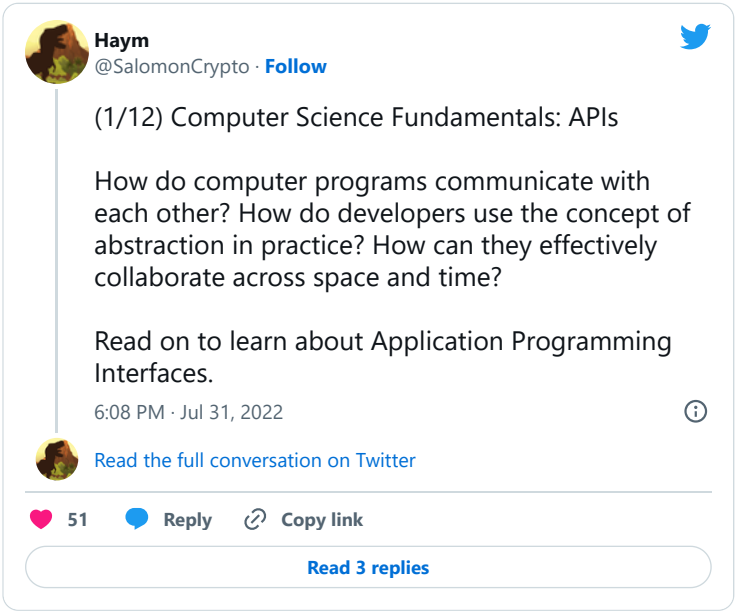
Or let's look at your browser wallet. It definitely doesn't have those hardware specs.

(18/28) Today, the way Alice, your wallet and most users access @ethereum is through a centralized Node-as-a-Service provider, like @AlchemyPlatform or @infura_io.

These companies operate full, normal Ethereum nodes, basically the same as if you were running one at home.

(19/28) Users can communicate with these nodes over the internet using an API.

They send their requests to the Node-as-a-Service provider who then interacts with @ethereum on their behalf (returning any output data through the same API).

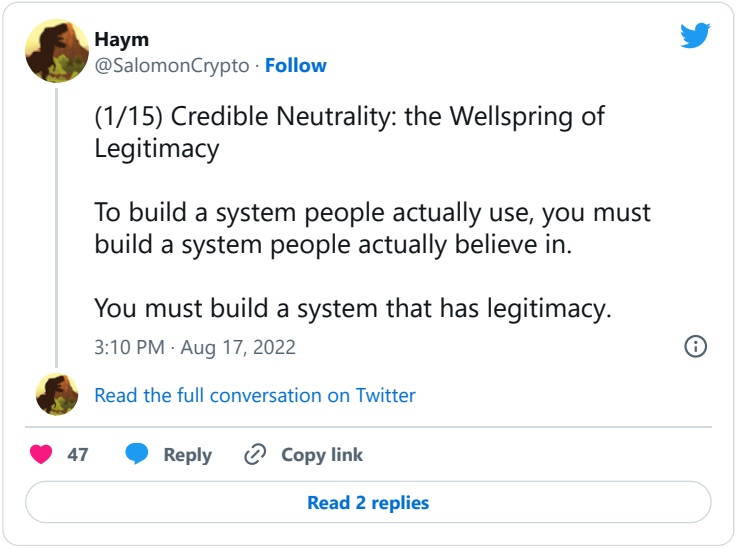


(20/28) This solution is super scalable; these two companies alone power the VAST majority of @ethereum requests. For example, every time @MetaMask does basically anything it does it through @infura_io.

The problem? We've basically given up decentralization.

(21/28) Bottom line is that if we give up decentralization, we give up credible neutrality and @ethereum along with it.

If the only way nearly everyone can access the World Computer is via @AlchemyPlatform's servers, we've basically just created a shitty version of AWS.



(22/28) Fortunately, that is NOT the endgame that we are all building toward. The @ethereum of the future is an Ethereum that supports light clients.

A light client is able to trustlessly connect with @Ethereum without running a full (heavy) node.

(23/28) A light client world is a completely different world; a MUCH cooler world.

We'll start by placing one directly in your browser smart wallet. Then every user can directly, trustlessly interact with @ethereum.

Then, the only limit is your imagination.

(24/28) Light client low hanging fruit: low-spec'ed computers, computers without steady access to that much bandwidth, smartphones, terminals, vending machines...

Let's just go for it... we can put an @ethereum light client in a smart contract on another blockchain!

(25/28) Today, we don't have light clients. The software hasn't been built and, besides, @ethereum can't really support them yet anyway.

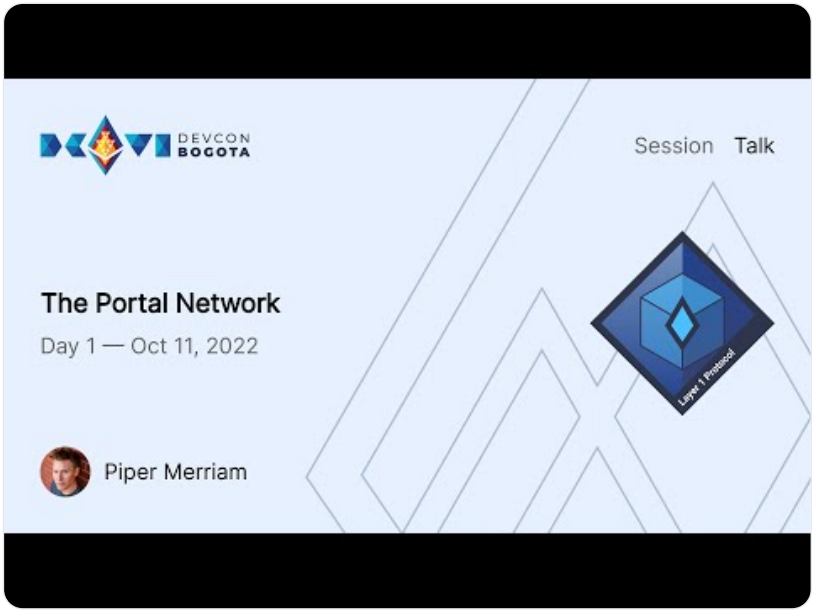
But we have gotten started. We've already built some of the more critical plumbing in to Ethereum PoS.

(26/28) Implementing state expiry and statelessness will be critical enabling light clients, but it is not enough.

Just take a look at our storage breakdown; only ~40% can be attributed to the state. We need to enable a MUCH lighter touch to achieve the light client-vision.

(27/28) But, as always with the World Computer, if the problems are understood then someone is probably working on it. This time, @pipermerriam (Portal Network) has us covered.

Feel free to watch ahead, but don't worry... this is where we are going.



https://www.youtube.com/embed/0stc9jnQLXA

(28/28) In conclusion, today there are two ways to access the World Computer: run your own node or ask a centralized actor to do it for you.

But that's just today, @ethereum is still evolving. Don't fall for the trap of believing this is all we get.

You ain't seen nothing yet.

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