



Ethereum

Ethereum is a public blockchain that runs smart contracts, which [ethereum.org](#) defines as programs that run on the Ethereum blockchain.

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AT A GLANCE

- 1 Ethereum has secured itself with proof-of-stake instead of mining since The Merge on September 15, 2022 ^[1].
- 2 Rule changes are written as Ethereum Improvement Proposals and adopted when node operators run new software, with no token vote ^[5].
- 3 Every transaction pays a protocol-set base fee, which is burned, plus an optional tip ^[3].
- 4 Since Dencun in 2024, layer-2 networks can post data to Ethereum as cheaper, temporary "blobs" ^[1].
- 5 The next upgrade, Glamsterdam, has no mainnet date; Ethereum.org expects Q4 2026, "date not yet confirmed" ^{[8][9]}.

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- v0.3.0 (2026-10-14; replaces v0.2.1, publish hash 9c91b597925b021d46b4cb234daede392e83f03d31e190bbfb7d942ce274124b): plain-English rewrite for learners. Adds an "At a glance" block, plain explanations of terms specific to this subject, labeled analogies, and "why it mattered" notes for each upgrade. Sources unchanged. No claim changes.
- v0.2.1 (2026-10-14; replaces v0.2, publish hash c40c35228549cf32240a0a228e6d49fed3b0f4bdbf6f0ce4317bfc2309246476): the page record now shows the published status, version, publish date and proof. Body wording: the policy line now names the Learning Hub; so does the line about the other dives. No claim changes.
- v0.2 (2026-10-06; replaces v0.1, sha256 4904395ee43eafb7d1df2ea9cff302dcc003b9aea96c3db3ad28bfd44352e6ea): sourced the smart-contract definition to ethereum.org's introduction to smart contracts, using its wording; described EIP-8038 as updating the cost of accessing state, not only reading it; applied "most" to flagged issues rather than contracts and named the outreach as aimed at the most-affected builders; removed the client-share percentages (a usage figure) and kept the 33% guideline and the page's out-of-date warning; removed an unsupported statement that no newer primary measurement exists; updated four redirecting ethereum.org source URLs to their final addresses; described EIP-8061 as higher exit and consolidation churn and added the ethereum.org Glamsterdam page as the source for faster exits; updated the Learning Hub label.

1. What it is

Ethereum and ether

Ethereum is a public blockchain that runs smart contracts, which ethereum.org defines as programs that run on the Ethereum blockchain ^[12]. Its native currency is ether (ETH), which pays for every transaction ^[3]. Vitalik Buterin published the introductory white paper in 2013, and the network went live as "Frontier" on July 30, 2015 ^[1].

How the rules change

Nobody owns Ethereum, and its rules change through an offchain process rather than a token vote ^[5]. Proposals are written up as Ethereum Improvement Proposals (EIPs), implemented by independent client teams, and bundled into network upgrades ^[5]. Node operators then choose whether to run the new software ^[5].

Analogy, not the mechanism itself: it is like a language with no central academy: new rules spread only if enough people start using them.

The Merge

Since September 15, 2022, Ethereum has secured itself with proof-of-stake instead of mining ^[1]. That switch is known as The Merge ^[1].

A base for layer 2s

Ethereum is also the settlement layer for many layer-2 (L2) networks, which execute transactions elsewhere and post their data back to Ethereum ^[4]. Two of the Learning Hub's other dives, [Arbitrum](#) and [Robinhood Chain](#), are L2s of this kind.

2. How it works

Execution and consensus clients

An Ethereum node runs two pieces of software ^[2]. The execution client handles transactions and the Ethereum Virtual Machine (EVM) ^[2]. The consensus client handles proof-of-stake ^[2]. A validator also runs a third piece, the validator client ^[2]. Since The Merge, the two layers upgrade together, which is why upgrades carry paired names such as "Pectra" (Prague plus Electra) ^[1].

Analogy, not the mechanism itself: the execution client is like a store's cash registers, and the consensus client is like the head office that agrees on the official daily books.

Many client teams

Several teams write these clients independently ^[5]. At the execution layer they include go-ethereum, Nethermind, Besu, Erigon and Reth ^[5]. At the consensus layer they include Prysm, Lighthouse, Nimbus, Teku, Lodestar and Grandine ^[5].

Slots, epochs and attestations

To become a validator, a user deposits 32 ETH into the deposit contract and joins an activation queue ^[2]. Time is divided into 12-second slots, and 32 slots make an epoch ^[2]. In each slot one validator is chosen at random to propose a block, and a committee of validators votes on it ^[2]. These votes are called attestations ^[2].

Checkpoints and the inactivity leak

A block becomes final through checkpoints ^[2]. When validators holding at least two-thirds of all staked ETH vote for a pair of checkpoints, the earlier one is finalized ^[2]. Reverting a finalized block would require an attacker to lose at least one-third of all staked ETH ^[2]. If the chain fails to finalize for more than four epochs, an "inactivity leak" drains stake from validators who are not voting with the majority, so the chain can recover ^[2].

Slashing penalties

Validators that break the rules are slashed ^[2]. The two slashable offenses are proposing two blocks in one slot and making contradictory attestations ^[2]. The penalty grows with the number of validators slashed around the same time, from under 0.1% of stake for an isolated case up to the whole stake in a mass event ^[2].

Fees and the base-fee burn

Every operation costs gas, and gas is paid in ETH ^[3]. A transaction pays a base fee set by the protocol plus an optional priority fee, or tip, for the validator ^[3]. The base fee is burned ^[3]. It moves up or down by at most 12.5% per block, depending on whether the previous block was above or below its target size, which is half the gas limit ^[3]. This fee design came from EIP-1559, part of the London upgrade of August 5, 2021 ^[1].

Analogy, not the mechanism itself: the base fee works like surge pricing that adjusts a little after each busy or quiet period, except that the base charge is destroyed rather than paid to anyone; the optional tip goes to the validator.

Blobs

L2 rollups post their transaction data to Ethereum so that the data inherits Ethereum's security ^[4]. Since the Dencun upgrade of March 13, 2024, they can post it as "blobs", a cheaper data type that is kept only for a limited time ^[1]. This change is EIP-4844, also called proto-danksharding ^[1].

Analogy, not the mechanism itself: a blob is like a parcel held at a pickup counter for a set time rather than filed in the permanent archive.

PeerDAS

The Fusaka upgrade of December 3, 2025 added PeerDAS ^{[1][7]}. Under PeerDAS, a full node no longer downloads every blob ^[7]. Each node holds a share of the data, and the network can rebuild any blob from half of the pieces ^[7]. Fusaka also lets clients raise blob capacity through small "blob-parameter-only" forks between major upgrades ^[7].

3. What changed

Timeline

Date	Event	Source
Jul 30, 2015	Frontier, the first live release	[1]
Jul 20, 2016	DAO fork; Ethereum Classic splits off	[1][5]
Dec 1, 2020	Beacon Chain (proof-of-stake chain) starts	[1]
Aug 5, 2021	London upgrade adds EIP-1559 base-fee burn	[1]
Sep 15, 2022	The Merge: proof-of-work switched off	[1]
Apr 12, 2023	Shapella enables staking withdrawals	[1]
Mar 13, 2024	Dencun adds blobs (EIP-4844)	[1]
May 7, 2025	Pectra: 2,048 ETH max effective balance; EIP-7702	[1]
Dec 3, 2025	Fusaka: PeerDAS, per-transaction gas cap	[1][7]
Oct 6, 2026	Glamsterdam scheduled on Sepolia testnet	[9]

Pectra (May 7, 2025)

What changed. EIP-7251 raised the maximum effective balance of a single validator to 2,048 ETH [\[1\]](#). EIP-7002 let a withdrawal address trigger exits directly [\[1\]](#). EIP-7702 lets an ordinary account run code like a smart contract, which allows features such as batched transactions and gas sponsorship [\[1\]](#).

Why it mattered. Ordinary accounts gained features such as batched transactions and gas sponsorship, and withdrawal addresses can now trigger exits directly [\[1\]](#).

Fusaka (Dec. 3, 2025)

What changed. Besides PeerDAS, Fusaka capped any single transaction at 16,777,216 gas (2^{24}) [\[7\]](#). It set a 10 MiB ceiling on block size [\[7\]](#). It also added a precompile for the secp256r1 curve, which lets wallets use device passkeys [\[7\]](#). A precompile is a built-in function contracts can call. Client teams shipped a 60 million default gas limit with it [\[7\]](#). The Ethereum Foundation says Fusaka raised the mainnet gas limit "on the path to 200M and beyond" [\[10\]](#).

Why it mattered. Nodes no longer download every blob, and wallets can use device passkeys [\[7\]](#).

Glamsterdam: what is in it

Glamsterdam combines the Amsterdam execution upgrade with the Gloas consensus upgrade [\[9\]](#). Its two headline changes are [\[8\]\[9\]](#):

- **Enshrined proposer-builder separation (ePBS, EIP-7732).** Today, validators who outsource block building rely on third-party relays outside the protocol [\[8\]](#). ePBS moves the hand-off and the builder's payment into the protocol [\[8\]\[9\]](#). Ethereum.org says it widens the window for spreading block data from about 2 seconds to about 9 seconds [\[8\]](#).

- **Block-level access lists (EIP-7928).** Each block records which accounts and storage slots it touches ^[9]. Clients can then read state and validate transactions in parallel ^[9].

Analogy, not the mechanism itself: an access list is like a recipe that names every ingredient up front, so several cooks can fetch them at once.

Why it matters. Ethereum.org and the Foundation describe in-protocol builder payments and parallel validation; none of it is on mainnet yet ^{[8][9]}.

| Glamsterdam: gas repricing

Glamsterdam also reprices gas ^[9]. EIP-8037 raises the cost of creating new state, and EIP-8038 updates the cost of accessing it ^{[9][11]}. Ethereum.org says EIP-8037 targets state growth of 120 GiB a year ^[8]. The Foundation warns that a small set of existing contracts may break or degrade under the new schedule without updates ^[11]. Other scheduled changes include ETH transfers emitting a log (EIP-7708) and higher exit and consolidation churn, which ethereum.org says lets stakers exit faster (EIP-8061) ^{[8][9]}.

Why it matters. Builders of the flagged contracts may need updates ^[11].

| Glamsterdam: dates

Glamsterdam was scheduled to activate on the Sepolia testnet on October 6, 2026 at 13:53:36 UTC, 9:53 a.m. ET ^[9]. The Foundation's announcement says mainnet and Hoodi dates "have not yet been decided" ^[9]. Ethereum.org lists mainnet as expected in Q4 2026, "date not yet confirmed" ^[8].

4. What is open

| Mainnet date and final scope

No mainnet date has been set ^[9]. Ethereum.org says scope "is frozen but can still change before mainnet, as the meta EIP remains in draft" ^[8]. The Foundation calls a 200 million gas limit a "credible post-Glamsterdam target" ^[10]. On Sepolia, at least two consensus clients default to 60 million gas after the fork unless validators set 200 million themselves ^[9].

| Contract breakage from repricing

The Foundation found that replaying past mainnet transactions under the new gas schedule flags a small set of contracts that may break or degrade ^[11]. Most flagged issues can be fixed with a higher gas limit, and outreach to the most-affected builders is under way ^[11]. How many affected contracts will be updated before mainnet is not known.

| Relays until ePBS ships

Until ePBS is live, proposers who outsource block building depend on off-protocol relays and trust between parties ^[8]. Even after ePBS, builders and proposers "might still choose to use off-protocol relays" for features the protocol does not cover ^[8].

Client concentration

A bug in a consensus client run by more than a third of nodes could stop finality ^[6]. A bug in a client with a two-thirds share could finalize an invalid chain ^[6]. Ethereum.org says that, ideally, no consensus client would reach a 33% share of nodes, and warns that its own client-share snapshot may be out of date ^[6].

Offchain governance

Upgrades depend on rough consensus among client teams, node operators and users, with no binding vote ^[5]. That makes contested changes slow by design ^[5]. It also means "who decides" has no single answer.

Staff changes at the Foundation

In May 2026 the Foundation's Protocol cluster said two coordinators were leaving and a third was going on sabbatical, during preparation for Glamsterdam ^[10]. The effect on delivery timelines, if any, is not stated.

What this page leaves out

By Learning Hub policy, this dive carries no price, market value, staking-yield or usage-volume figures. Those go stale, and News covers them.

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