

Solana

Solana is a proof-of-stake blockchain.

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- v0.3.0 (2026-10-14; replaces v0.2.2, publish hash 7595b2ed080f1d5e6a456a88c529fcfac5fa93b859596aaab2df5fda554fb773): 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.
- v0.2.2 (2026-10-14; replaces v0.2.1, publish hash 0531d1cf081f925629f2190c7d1b3ebd965bfa727157ebb4de4e0dadb1aac05b): the page record now shows the published status, version, publish date and proof. Body wording: the policy line now names the Learning Hub. No claim changes.
- v0.2.1 (2026-10-06; replaces v0.2, sha256 a040ab78d2c8fcf3948a45979fcf33a3a2b531fa64959d05a7c344f595984f35): cited the opening "proof-of-stake" description to Solana's Staking page, added as a source, because the page cited before did not use that phrase.
- v0.2 (2026-10-06; replaces v0.1, sha256 aa4bfcd99a68c8beda8c9d6eac266dcd27700f5751ccf17c8d7213fa05cacf8): cut an unsourced single-chain claim from the opening line; replaced "main validator software" (a client-share claim) with the fact that protocol upgrades ship in Agave releases; defined the lamport from Solana's Terminology page, added as a source; noted that the prioritization fee is a flat lamport total in the new v1 transaction format; added Anza's SDK source, pinned to a commit, as the source that the inflation figures are yearly; rewrote the mainnet RPC source in the chain-state format with a fresh, reproducible read (epoch 1050, slot 453,977,078) and its returned values; rewrote the 2,000-validator cap using Solana's validator-admission page, added as a source, which says validators outside the top 2,000 by stake are excluded for that epoch; removed an unsupported claim that misbehaving validators lose rewards but not stake; removed an uncited sentence about third-party client trackers; updated the Learning Hub label.

1. What it is

Solana and SOL

Solana is a proof-of-stake blockchain ^[16]. Its native token is SOL, which pays transaction fees and is staked to validators ^{[3][4]}.

Proof of History

Anatoly Yakovenko's white paper introduced its signature idea, Proof of History (PoH): a way to record the order of events and the time that passes between them inside the ledger itself ^[10].

Analogy, not the mechanism itself: PoH is like a ticking clock printed into every page of a logbook, so anyone reading it can see what came first and how much time passed.

Clients and feature gates

Solana's protocol upgrades ship in releases of Agave, the validator client maintained by Anza ^{[5][6]}. A second, independent client, Firedancer, is built by Jump Crypto ^[11]. Protocol changes are written up as Solana Improvement Documents (SIMDs) and switched on through on-chain "feature gates" ^{[6][7]}. A feature gate is an on-chain switch that turns a change on for the whole network at a set point.

Many changes at once

Solana is partway through several protocol changes at once ^[5]. Alpenglöw, described by the Solana Foundation as "Solana's first major consensus replacement since TowerBFT," is still pending ^[6]. Meanwhile its slot time is being cut from 400 milliseconds to 200, and storage deposits are being cut by 90% ^{[7][8]}. This dive describes the network as it runs on October 6, 2026, and flags which pieces are still pending.

2. How it works

Accounts and programs

Everything on Solana is stored in accounts ^[1]. Each account has five fields: its balance in lamports (one lamport is 0.000000001 SOL), its data, its owner, an executable flag and a deprecated rent field ^{[1][15]}. Programs, Solana's smart contracts, are accounts with the executable flag set ^[2]. Programs hold no state of their own ^[2]. All changeable state lives in separate data accounts that are passed to the program ^[2]. A program can be upgraded while it has an upgrade authority, and becomes immutable once that authority is revoked ^[2].

Analogy, not the mechanism itself: a program is like a calculator with no memory; you hand it the notebooks (data accounts) it should read and write each time.

Rent deposits

Every account must hold a minimum balance sized to its data ^[8]. Solana calls this "rent," but it works as a refundable deposit ^[8]. When the account is closed, the whole amount goes back to whoever closes it ^[8].

Leaders and slots

Time on Solana is divided into slots ^[7]. A slot is a short, fixed time window in which one block can be made. For each slot, one pre-assigned validator, the leader, builds the block ^[6]. Each leader gets four slots in a row ^[7]. Validators with more stake delegated to them are chosen as leader more often ^[4]. An epoch is a fixed 432,000 slots ^[7].

Gulf Stream, ticks and Turbine

Transactions are forwarded directly to the upcoming leader, a design Solana calls Gulf Stream ^[7]. The leader's PoH stream emits 64 "tick" entries per slot, evenly spaced, which pace block production today ^[6]. Block data is spread across the network by a protocol called Turbine ^[6].

TowerBFT today

Under the current consensus protocol, TowerBFT, validators vote by sending transactions ^[6]. A block is final once enough of those votes have stacked up over 32 slots, which takes about 12.8 seconds ^[6]. Most applications read at the faster "confirmed" level, which arrives in about one slot ^[6]. Solana's docs note that a confirmed block could, in principle, still be dropped ^[6].

Fees and compute units

Every transaction pays a base fee of 5,000 lamports per signature ^[3]. Half of the base fee is burned and half goes to the validator ^[3]. Users can add a prioritization fee, which goes entirely to the validator ^[3]. In older transaction formats it is priced per compute unit ^[3]. A compute unit is Solana's measure of how much processing a transaction uses. In the new v1 format it is a flat lamport total ^[3]. A transaction can request at most 1.4 million compute units ^[3]. Since Agave 4.1, a block can hold 100 million compute units, up from 60 million ^[5].

Staking and issuance

SOL holders stake by delegating to validators, who charge a commission on rewards ^[4]. Solana's staking documentation says there is currently no slashing in the protocol, though it could be added in the future ^[4].

New SOL is issued on a fixed schedule ^[12]. Mainnet reports an initial rate of 8% a year, falling by 15% each year toward a long-term rate of 1.5% ^{[12][14]}. For epoch 1050, the network reported a current inflation rate of about 3.6% ^[12].

3. What changed

Timeline

Date	Event	Source
May 2026	Agave 4.1: 100M compute-unit blocks; Validator Admission Ticket code	^[5]
Jul 8, 2026	BLS key management in vote accounts (SIMD-0387) live on mainnet	^[6]
Jul 22, 2026	Validator Admission Ticket (SIMD-0357) live on mainnet	^[6]
Aug 4, 2026	Firedancer v1.1.3 tagged "mainnet ready"	^[11]
Aug 2026	Agave 4.2 ships	^[5]
Aug 21, 2026	Slot time cut to 350ms (epoch 1020)	^[7]
Aug 28, 2026	Slot time cut to 300ms (epoch 1024)	^[7]
Sep 3, 2026	First rent cut: 6,960 to 6,333 lamports per byte	^[8]
Sep 15, 2026	Maximum transaction size raised to 4,096 bytes	^[9]
Sep 18, 2026	Slot time cut to 250ms (epoch 1037)	^[7]
Pending	200ms slots, scheduled for epoch 1052	^[7]
Pending	Alpenglow consensus (Agave 4.3)	^{[5][6][12]}

Shorter slots (SIMD-0525)

What changed. SIMD-0525 cuts slot time from 400 milliseconds to 200 in four steps of 50 milliseconds, each behind its own feature gate ^[7]. Three steps are live, so mainnet runs at 250 milliseconds ^[7]. The last step is scheduled for epoch 1052, and the rollout pauses if block skip rates rise too high ^[7]. Ticks per slot, the four-slot leader span and the epoch length in slots stay the same ^[7]. One knock-on effect: a transaction's blockhash expires after 150 blocks, so it now goes stale after about 50 seconds rather than 80 ^[7]. A blockhash is the recent-block reference each transaction carries.

Why it mattered. Blocks come faster, and apps have less time before a signed transaction goes stale ^[7].

Cheaper storage deposits

What changed. SIMD-0437 cuts the per-byte deposit from 6,960 lamports to 696, a 90% reduction, in five feature-gated steps ^[8]. The first step took effect at epoch 1028 on September 3, 2026 ^[8]. Steps 3 to 5 are planned for Agave 4.4, expected in November 2026 ^[8].

Why it mattered. Creating accounts that store data needs a smaller deposit, starting with the first step ^[8].

Bigger transactions

What changed. The maximum transaction size rose from 1,232 bytes to 4,096 bytes on September 15, 2026, through a new "v1" transaction format ^[9]. Older formats still work, and apps that want the extra room must switch to v1 ^[9].

Why it mattered. Builders can fit more into one transaction if they switch to v1 ^[9].

Validator admission (VAT)

What changed. The Validator Admission Ticket (VAT) is a step toward Alpenglow ^[6]. Since it went live on July 22, 2026, validators that have not registered a BLS public key are excluded from the admitted set and stop taking part in consensus ^[6]. A BLS key is a type of signing key whose signatures can be combined. Solana's upgrade page lists a maximum of 2,000 admitted validators ^[5]. It also lists a 1.6 SOL VAT fee that applies after the full Alpenglow migration ^[5].

Why it mattered. Validator operators had to register a BLS key to keep taking part in consensus ^[6].

Alpenglow, pending

What it would change. Alpenglow replaces TowerBFT ^[6]. Its first phase, Votor, has validators send votes directly to each other and bundle them into certificates instead of posting vote transactions ^[6]. A block is final after one round if at least 80% of stake votes for it, or after a second round with 60% thresholds ^[6]. Solana targets finality of about 150 milliseconds, down from about 12.8 seconds ^[6]. Votor is designed to keep working with 20% of stake acting maliciously plus another 20% offline ^[6]. Under Alpenglow, PoH no longer paces block production, ticks leave the ledger, and "confirmed" and "finalized" become the same level ^[6]. The second phase, Rotor, would replace Turbine and "is not yet scheduled" ^[6]. Execution, transaction formats and fees do not change ^[6].

Analogy, not the mechanism itself: TowerBFT is like voting by mailing ballots that get filed in the public record; Votor is like a show of hands tallied into a signed certificate.

Why it matters. Solana's stated target is finality of about 150 milliseconds; it is not live yet ^[6].

4. What is open

When Alpenglowlow reaches mainnet

Solana's Alpenglowlow page, updated September 2026, gives an expected mainnet date of "Q3 2026, on Anza's v4.3 release schedule" ^[6]. The upgrades index lists Agave 4.3 as "Expected October 2026" and "In Development" ^[5]. On October 6, 2026, a mainnet RPC node running Agave 4.3.0 returned null for the Alpenglowlow genesis certificate, which Solana's docs say means the cluster is still on TowerBFT ^{[6][12]}. No mainnet activation date appears in the primary sources we reviewed.

Rotor

The data-spreading half of Alpenglowlow has no schedule ^[6]. Until it ships, Turbine stays in place ^[6].

A new trust model for the clock

Under Alpenglowlow, a block's timestamp is set by its leader within a bounded range, instead of being the stake-weighted median of validator votes ^[6]. Solana's docs say a dishonest leader can push the clock ahead, and the room to do so grows after skipped slots ^[6]. Programs that depend on precise time will need to be rechecked ^[6].

A capped validator set

The VAT admits at most 2,000 validators ^[5]. Solana's VAT page says validators with a registered BLS key but outside the top 2,000 by stake are left out of the admitted set for that epoch ^[13].

No slashing

Solana's staking documentation says there is no slashing in the protocol today ^[4]. The same page links to a slashing roadmap but gives no date for adding slashing ^[4].

Client concentration

Firedancer's repository describes two products ^[11]. Full Firedancer shares no code with Agave ^[11]. Frankendancer is a hybrid that still uses Agave for execution and consensus ^[11]. We found no primary measurement of how much stake runs each client, so this page gives no share figures.

Many moving parts at once

Slot-time cuts, rent cuts, a new transaction format, validator admission and a new consensus protocol are all rolling out within a few months ^{[5][6][7][8][9]}. Each step is gated and can be paused ^[7]. The combined risk of changing these pieces together is not assessed in the sources.

What this page leaves out

By Learning Hub policy, this dive carries no price, market value, staking-yield or usage-volume figures. Transaction counts in particular will drop when vote transactions leave blocks under Alpenglowlow, which Solana says is "an accounting change, not a throughput regression" ^[6].

Sources

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- 12 Solana chain state via Solana Labs public RPC, methods `getEpochInfo`, `getInflationGovernor`, `getInflationRate`, `getAgGenesisCert` and `getVersion`, epoch 1050, slot 453,977,078. Endpoint <https://api.mainnet-beta.solana.com> (JSON-RPC POST, no params), queried October 6, 2026 at 2:06 p.m. ET; all five calls answered within epoch 1050, between slots 453,977,078 and 453,977,111 (`getEpochInfo` before and after). Returned: `getInflationGovernor` initial 0.08, taper 0.15, terminal 0.015, foundation 0.0; `getInflationRate` epoch 1050, total 0.03615736122411238; `getAgGenesisCert` null; `getVersion` solana-core "4.3.0", feature-set 3383571666. `getInflationGovernor`, `getInflationRate`, `getAgGenesisCert` and `getVersion` take no slot and report the state at query time; `getVersion` reports the answering node's own software, not the whole cluster. No explorer cross-check available. Method references: <https://solana.com/docs/rpc/http/getepochinfo> and <https://solana.com/docs/rpc/http/getinflationgovernor>
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