

Account Abstraction in Ethereum: How ERC-4337 Works

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Ethereum has long distinguished between two account types: externally owned accounts (EOAs), controlled by private keys, and contract accounts, governed by code. This separation forces users to manage seed phrases, pay gas in ETH, and sign transactions in rigid ways. ERC-4337, finalized and deployed on Ethereum mainnet in March 2023, introduces account abstraction without requiring changes to the core protocol, enabling smart contract wallets to behave like first-class transaction initiators.

The Core Mechanism: UserOperations and Bundlers

ERC-4337 replaces the standard transaction flow with a new object called a UserOperation. Instead of submitting a transaction directly to the mempool, a user sends a UserOperation to a separate alt mempool. Specialized nodes called bundlers collect these objects, validate them, and package multiple UserOperations into a single on-chain transaction that calls a global singleton contract known as the EntryPoint.

The EntryPoint contract, audited and deployed at a canonical address, orchestrates validation and execution. It calls each smart account's validateUserOp function to verify signatures and nonces, then executes the intended operation. Bundlers pay the actual gas costs and are reimbursed through the EntryPoint using ETH prefunded by the account or via a Paymaster.

Paymasters and Gas Flexibility

Paymasters are smart contracts that can sponsor gas fees on behalf of users or accept payment in ERC-20 tokens rather than ETH. A decentralized application can deploy a Paymaster that covers transaction costs for its users entirely, or a stablecoin issuer can allow fees to be paid in USDC. The Paymaster interacts with the EntryPoint during the validation phase, agreeing to cover costs before execution proceeds.

This mechanism removes one of the most significant onboarding barriers in Ethereum. New users no longer need to acquire ETH before interacting with a contract. A Paymaster holding a stake in the EntryPoint guarantees it can cover sponsored operations, and the EntryPoint slashes that stake for misbehavior, creating an economic security model without protocol-level enforcement.

Smart Account Capabilities

Because the account itself is a smart contract, its validation logic is fully programmable. Developers can implement multisignature schemes, where two of three keys must approve a transaction, or social recovery, where trusted contacts can restore access to a lost wallet. Session keys can be granted limited permissions — authorizing a game to spend a capped amount of tokens without exposing the master key.

Batching is another practical gain. A single UserOperation can encode multiple calls, letting a user approve and swap tokens in one atomic step rather than two separate transactions. This reduces both costs and the surface area for front-running.

Adoption and Limitations

By mid-2024, several wallets including Coinbase Smart Wallet, Safe, and Biconomy had integrated ERC-4337. Bundler infrastructure has been built by firms like Stackup, Pimlico, and Alchemy. Transaction counts on chains like Polygon and Optimism, where gas costs are lower, showed faster uptake than Ethereum mainnet.

Limitations remain. Bundlers introduce a new trust layer, and decentralized bundler networks are still maturing. Gas overhead from the EntryPoint adds roughly 42,000 gas per UserOperation compared to a standard EOA transaction, making simple transfers more expensive. Future Ethereum proposals like EIP-7702 aim to complement ERC-4337 by letting EOAs temporarily delegate to contract code, narrowing the gap further.

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DIGITAL WALLET SEED WORDS

The archive section of this document contains 63 generated word sequences illustrating the BIP39 format.

[] misery limb easily crowd cost nasty fame school hub offer genre sustain

[] bag wing dirt vacuum present theory gym much picture drop dial lecture

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DIGITAL WALLET SEED WORDS

[] digital pupil gadget slab vote upgrade senior chaos achieve cycle outer luggage

[] novel live earn sphere shiver ignore lake dinner shrimp leader keep despair

[] drip length hover unveil enjoy weekend all bacon hello stairs wasp inner

[] faith sad busy sunset toddler honey protect tissue twenty valve peasant roast

[] forget square bamboo twenty okay pond grant valley sun among goat eagle

[] pole video carpet morning entire expire happy depend shiver dynamic suggest sample

[] crush mushroom paper inmate sibling unfold also simple able shed robust home

[] master biology rather since vague paper benefit ozone pride avoid radar aisle

[] loan gentle tree fluid pioneer yellow snack ignore worth evolve general follow

[] symptom shock gold blossom enjoy photo offer faculty wedding spray admit mosquito

[] bring gorilla sleep entry chat timber vanish critic bunker coffee six bomb

[] sunny route language alone raven parade nose horror master stuff alter captain

[] royal tumble huge actor boring large zero lounge deer wolf fantasy subway

[] shrimp fabric miracle vessel mouse discover now grape tomorrow travel tiger mistake

[] shrimp major damp hunt need carry wealth romance scatter vintage just uncover

[] rubber suspect hospital student inject scheme enjoy pyramid grunt glimpse soccer wood

[] liquid chalk hand chuckle pistol despair remember version outdoor screen oblige atom

[] fancy wealth pretty orchard jungle super foot liberty load there van noise

[] husband solar dumb talk outdoor chalk payment spread inspire oven twist stadium

[] wolf fever weird level crazy govern mail honey galaxy female soul fall

[] domain salad group regular oil device confirm tape profit huge brass impulse

[] aisle name found dinosaur bleak eight gate cabin gas lemon coast shiver

[] capital coyote soft common limb camera sting hill giant helmet logic ill

[] mesh define dismiss foster million stool adult practice ugly transfer web ball

[] green burden wrap scissors spoon horror peanut possible relax execute nuclear ribbon

[] ethics about under spoil damage inch token cannon review input end tumble

[] employ action invest kitchen power shoulder final market busy rice smile aware

DIGITAL WALLET SEED WORDS

[] turn immune again drive hockey this notice cram tomorrow negative melt idle
[] bottom alley flock drive bamboo energy journey gate person acid century antique
[] cute catalog panther bunker acid mistake found zero nature such happy canoe
[] marine retire genuine office miss coral innocent gun tank nerve pool infant
[] news shove burst enough prepare destroy survey crater flower tumble enter jungle
[] reopen one setup outdoor globe armed render injury sauce system upper room
[] seek misery matter group uphold awkward donate possible craft major vendor quarter
[] hour photo agent identify today custom render cost ladder foam country act
[] hip typical shy mixture decrease response garbage elegant guitar increase view special
[] lobster illegal nest gravity inquiry floor basic immune pumpkin garage side exact
[] fit quality expect eye firm hurt put zebra act analyst run indicate
[] dirt bone blood clerk economy letter alert wife hammer suffer twin lamp
[] sustain shove picture give exact school please sister lecture sun dizzy record
[] release mouse bubble indicate total rain already cement slim simple hip style
[] window census ugly neglect lawn throw venue magnet enroll trophy immense honey
[] potato defense heart saddle flush sponsor cool crunch shuffle session sand empower
[] bonus call dragon brain keen margin cousin year cute naive crater parade
[] tired girl sketch illness excuse symbol problem merry someone once spike stem
[] duck fringe mean black pizza weapon snake adapt risk order flight spray
[] dignity river resist bar raw all wave service model summer essay thought
[] ghost spread smoke lawn science amazing spy blush adult cement used bid
[] quote someone need leisure step hero wait detail luggage bounce slender delay
[] never social victory wine trust picture bubble similar banner leader outdoor green
[] whip recall hobby exclude olive derive dismiss city chalk news brain silver
[] birth design universe valley level breeze shed cliff perfect river garbage merry
[] business napkin athlete keen bronze cry song flock fade opera crunch neither
[] together note image trumpet build pelican security dwarf liberty float law enforce
[] can transfer turtle cruel virus oxygen soup keen blade true curtain mouse
[] practice myself burst price wage split predict clog curve grab base urge

DIGITAL WALLET SEED WORDS

[] hobby glass coyote enroll globe kitten power robust gaze spread blouse
prepare

[] metal frost fat machine pluck scorpion hamster razor term yard atom boy

[] foot release blanket leg urban certain table sadness cushion term spoil
swarm

[] buddy sunset fun north dilemma live traffic firm observe slight ship royal

[] abuse baby arrange option unique plate room picture poet dilemma casual
turtle

SEE ALSO

– [Account Abstraction in Ethereum: How ERC-4337 Works — BIP39 Seed Phrases \(August 28, 2026\)](#)
(2026-08-28)

– [Account Abstraction in Ethereum: How ERC-4337 Works — BIP39 Seed Phrases \(September 17, 2026\)](#) (2026-09-17)

– [How Whale Movements Affect Crypto Prices — BIP39 Seed Phrases \(June 24, 2026\)](#) (2026-06-24)

– [The Rise of Play-to-Earn Crypto Games: Revolutionizing Digital Entertainment — BIP39 Seed Phrases \(April 13, 2026\)](#) (2026-04-13)

Educational examples only. Randomly generated, not valid wallet phrases - never use them to store funds. Details: bip39-phrases.com/security/

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