Cheatcalls EIP

Standardizing JSON-RPC interface for development nodes

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Ethereum nodes landscape

Production nodes

geth, nethermind, erigon, reth, prysm…

Development nodes

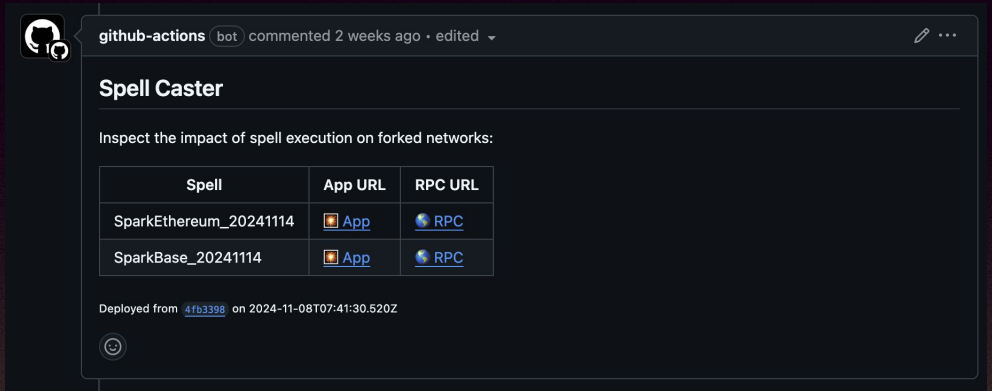
anvil (foundry), hardhat node, tenderly, build bear

Test environments

foundry, hardhat

Why development nodes are so useful?

* Can be local or running in the cloud (devnet)
* Use cases:
  * Forking support
  * **Simulating governance spell execution**
  * E2E / **Integration Tests** for different systems
  * Private testnets
* Limited control with **special** JSON-RPC methods



Special JSON-RPC calls

* evm_setNextBlockTimestamp
* evm_revert
* tenderly_setErc20Balance
* anvil_mine
* . . .

Cheatcalls EIP

Cheatcalls EIP

* **Standard to be implemented** by Development nodes
* Like Foundry’s cheatcodes but for json-rpc
* Increases nodes interoperability
* Test suite to verify spec conformance
* Share **cheat_** prefix

* Gives full control over the node to developers
  * Time management
  * Mining control
  * Snapshots
  * Impersonation
  * Balance and storage management

Time management

* **cheat_increaseTime(deltaSeconds: Quantity)**
  * Mines a new block with a timestamp of lastTimestamp + deltaSeconds
* **cheat_setNextBlockTimestamp (nextTimestamp: Quantity |’default’)**
  * Does not mine a new block, but once new block is mined, it will have timestamp of exactly nextTimestamp. Any methods reading state such as eth_call respects new timestamp when queried for 'pending' block.
  * To unset, call with ‘default’

Mining control

* cheat_mine(count: Quantity = 1, gapSeconds: Quantity = 1)
* cheat_mining_mode(mode: Mode)
* cheat_dropTransaction(hash: Data)

```
type InputMiningMode =
  | { type: "auto" }
  | { type: "manual"; ordering?: MiningOrdering }
  | { type: "interval"; intervalSeconds: Quantity;
ordering?: MiningOrdering };

type MiningOrdering =
  | "highest-fee-first" // default
  | "oldest-first"
  | "random";
```

Snapshots

* **cheat_snapshot(): Data**
  * Snapshots current state of the blockchain, including Cheatcalls related state like timestamp of a next branch. Returned value can be any hex string but has to be unique.
* **cheat_revertSnapshot(id: Data)**
  * Reverts to a given snapshot. Throws if snapshot id was not found. Revert multiple times to the same snapshot MUST be supported.

Impersonation

* `cheat_impersonateAllAccounts()`
* `cheat_stopImpersonatingAllAccounts()`
* `eth_sendTransaction` vs `eth_sendRawTransaction`

Meta

* cheat_info()
  * Returns status of the whole node and cheatcodes (next timestamp, mining mode etc.)

```
interface CheatcallsInfo {
  cheatcallsSpecVersion: string;
  runMode: RunMode;
  miningMode: MiningMode;
  impersonateAllEnabled: boolean;
  nextBlockTimestamp: Quantity;
  minGasPrice: Quantity;
  gasLimit: Quantity;
  nextBlockBaseFeePerGas: Quantity;
}
```

Balance and storage management

* cheat_setBalance(account: Address, balanceInWei: Quantity)
* cheat_setErc20Balance(token: Address, account: Address, balanceInBaseUnit: Quantity)
  * Best effort implementation
* cheat_setStorageAt(account: Address,slot: Data, value: Quantity)

Tangent: How does setting ERC20 balance work?

* Problem: we can tweak arbitrary storage slots but we don’t know which slot holds particular user ERC20 balance
* EVM Storage is a huge map **uint256 -> uint256** scoped for each contract
* Solidity storage layout
  * Each property has an order dependent index
  * Mappings select slots based on a hash of an index and keys

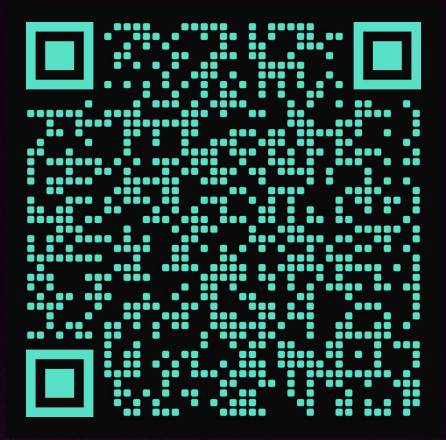
Tangent: How does setting ERC20 balance work? (part 2)

1. Trace **balanceOf(account)** read - **eth_createAccessList**
2. Find all accessed storage slots
3. Tweak **{i}** accessed storage location with random value {x}
4. execute **balanceOf(account)** again,
5. If **{x}** was returned we **{i}** is the storage slot that we were looking for
6. If not go back to step 3 and check next storage slot
7. Set final value on slot {i}

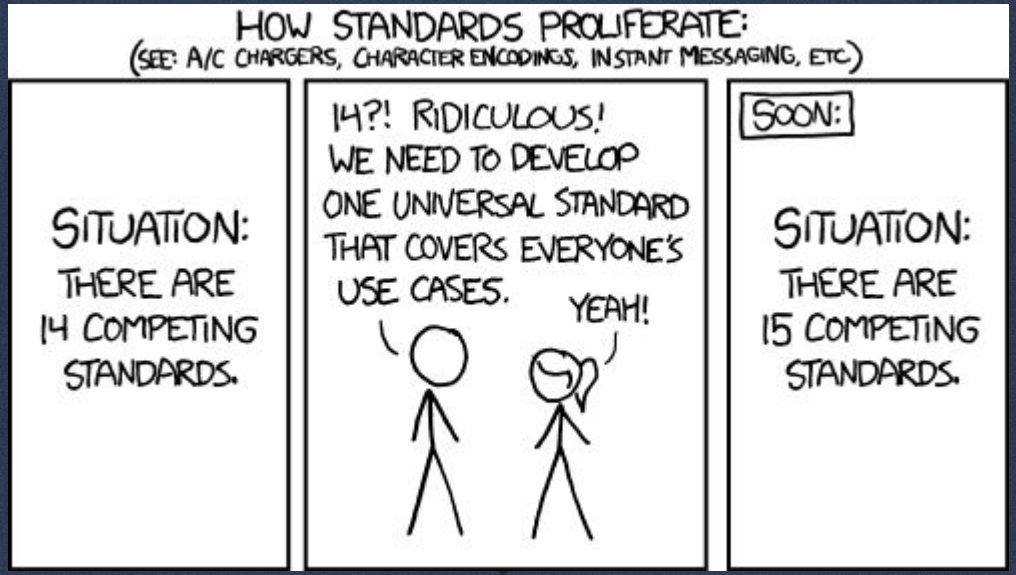
Example implementation: [forge-std/StdStorage]

Current state of the EIP

* Pre-draft ready and submitted to eth-magicians
* 3 contributors and more reviewers
  * Special thanks to: **Piotr Szlachciak** and **Emmanuel Antony**
  * Foundry, Hardhat, Tenderly, BuildBear teams are aware



Future of the EIP



Alternative, client side approach

Viem / ethers.js client

- Best effort attempt to reduce incompatibilities
- Many features won't be available
- Can warn users about incompatibilities
- Use viem-deal like approach to implement **setErc20Balance** user side

Thank you!

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