

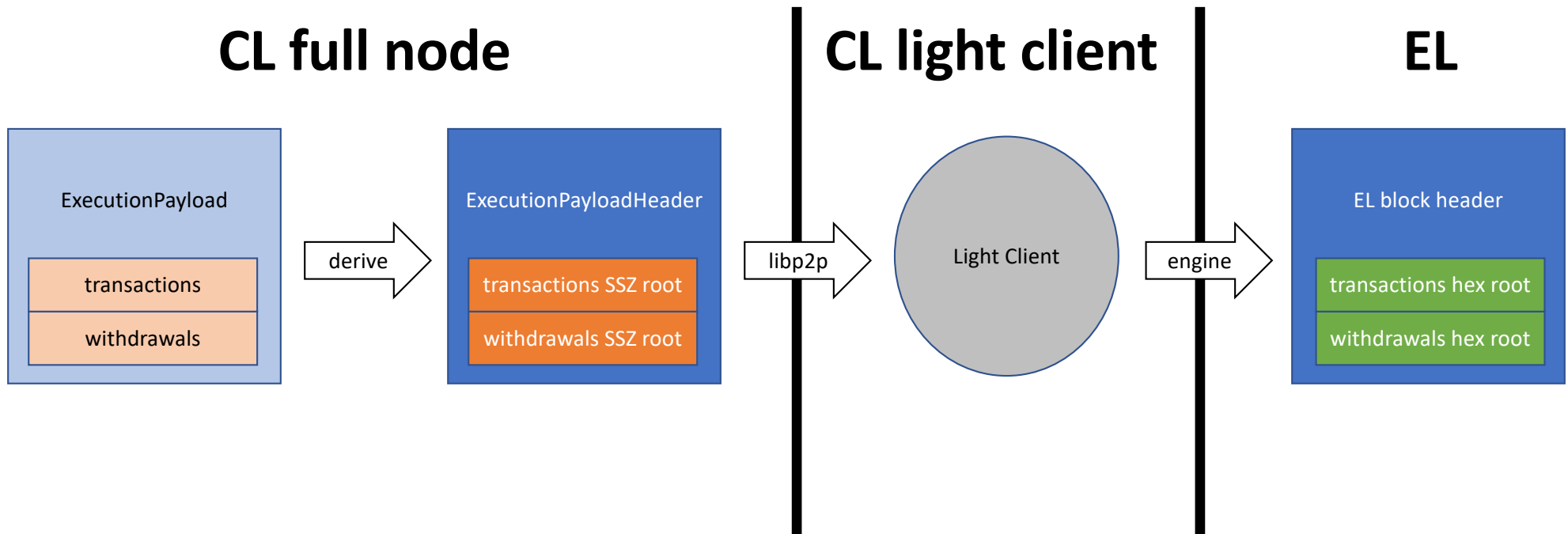
EL block header

keccak256 of RLP	parent_hash
constant	ommers_hash
address	coinbase
hexary trie root of RLP	state_root
hexary trie root of RLP	txs_root
hexary trie root of RLP	receipts_root
bloom filter	logs_bloom
constant	difficulty
number	number
number	gas_limit
number	gas_used
number	timestamp
0 ... 32 bytes	extradata
32 bytes	prev_randao
constant	nonce
number	base_fee_per_gas
hexary trie root of RLP	withdrawals_root
number	excess_data_gas

CL ExecutionPayloadHeader

keccak256 of RLP	parent_hash
address	fee_recipient
hexary trie root of RLP	state_root
hexary trie root of RLP	receipts_root
bloom filter	logs_bloom
number	block_number
number	gas_limit
number	gas_used
number	timestamp
0 ... 32 bytes	extra_data
32 bytes	prev_randao
number	base_fee_per_gas
SSZ tree root of RLP	transactions_root
SSZ tree root of SSZ	withdrawals_root

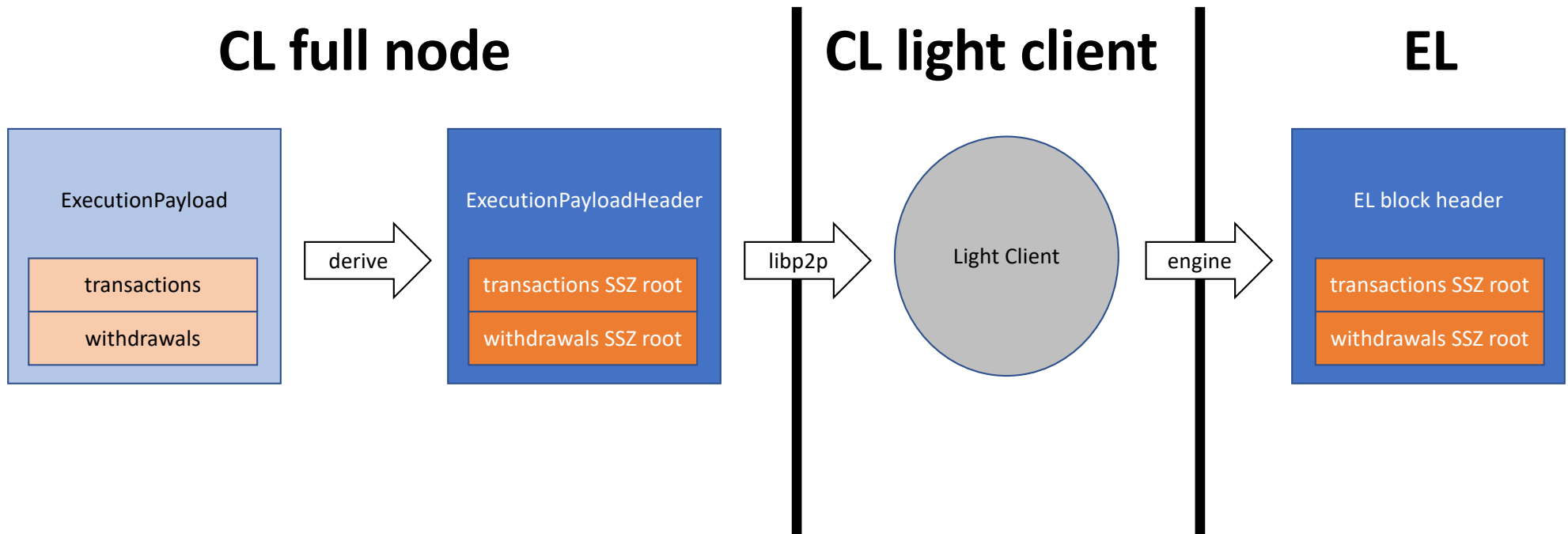
[ethereum/consensus-specs > PR #3078](https://github.com/ethereum/consensus-specs/pull/3078)



Current situation: Format inconsistency

- EL uses hexary trie roots for transactions / withdrawals in block header
- CL uses SSZ tree roots for transactions / withdrawals in payload header
- Issue recurring every time new list is added
- Cannot validate *ExecutionPayloadHeader's* `block_hash` without obtaining more data

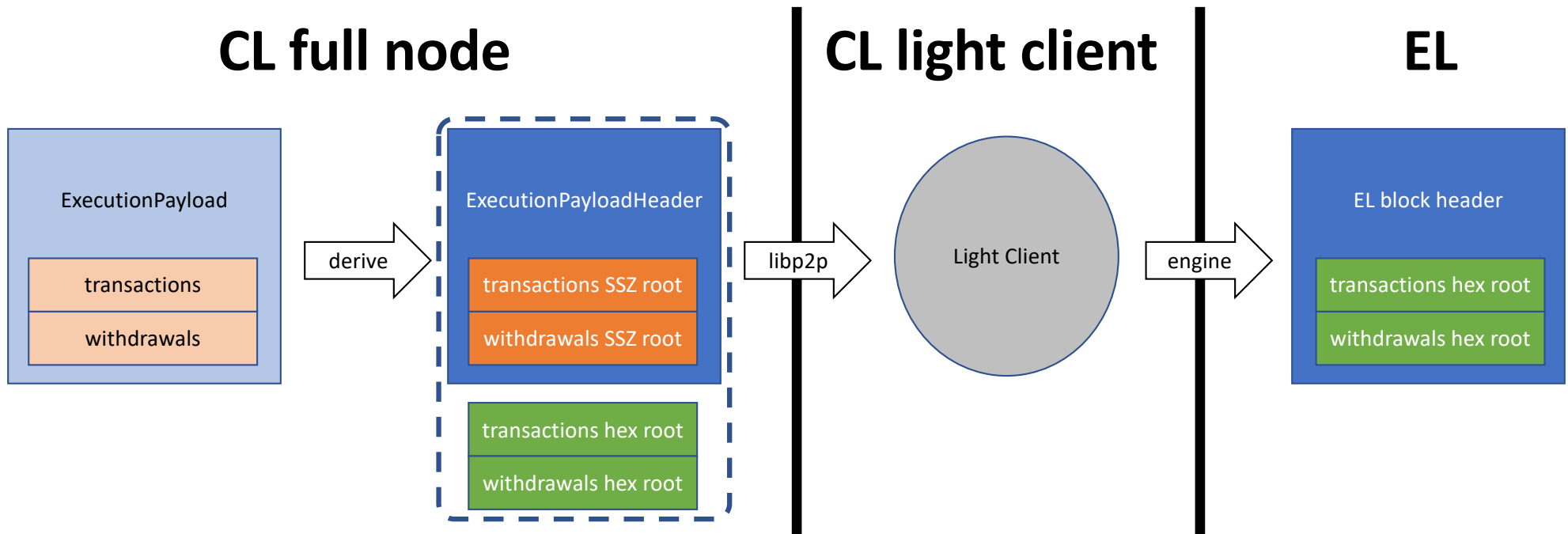
[ethereum/consensus-specs > PR #3078](https://ethereum.consensus-specs.org/PR-3078)



Option A: Transition *transactions* and *withdrawals* to SSZ in EL

- EL implementations need support for SSZ format
- Smart contracts may want support for SSZ proof validation
- Same format in both CL and EL

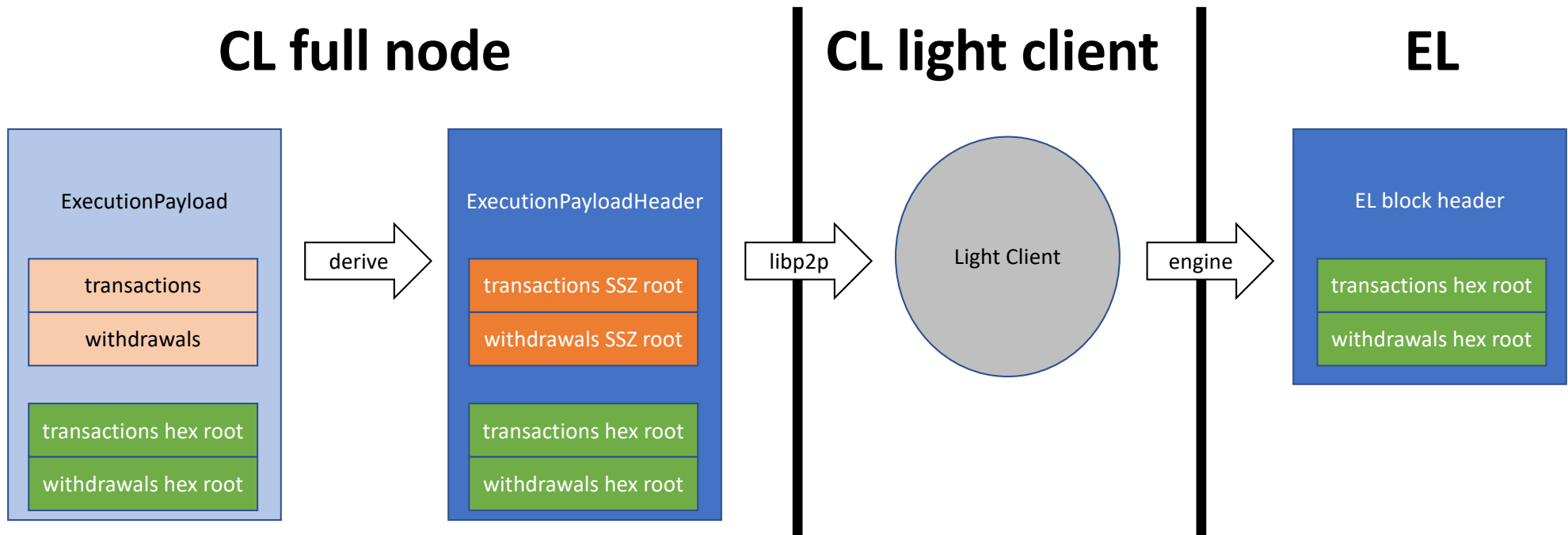
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Option B: Sidecar with hexary trie roots

- CL implementations need support for legacy formats: RLP, Hexary trie, Keccak256
- Alternative: CL fetches hex roots with *eth_getBlockByHash* (interference with validator duties?)
- New API: *engine_newPayloadHeaderV1*

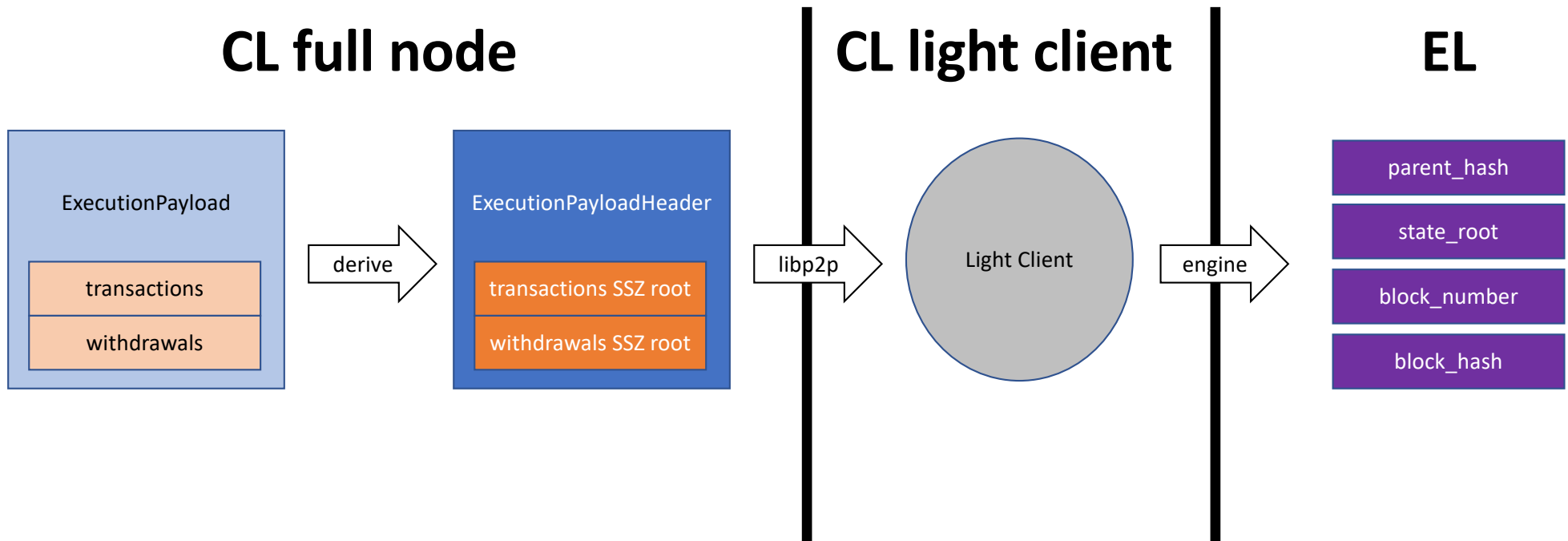
[ethereum/consensus-specs > PR #3078](https://ethereum-consensus-specs.github.io/PR-3078)



Option C: Extend *ExecutionPayload* with hexary trie roots

- Same approach as for *block_hash*, CL can treat hex roots as opaque
- Extend API: *engine_getPayloadV2*, *engine_newPayloadV2* (to pass hex roots in/out)
- Hex roots are validated inside EL to match *transactions* and *withdrawals* lists
- 64 bytes per block: 160 MB / year

[ethereum/consensus-specs > PR #3078](https://ethereum-consensus-specs.github.io/PR-3078/)



Option D: Providing just enough for syncing

- EL fetches EL block header and EL block data from network
- Additional latency to Req/Resp full EL block header, cannot follow passive gossip
- New API: `engine_newPayloadSyncContextV1` - [ethereum/execution-apis > PR #318](https://ethereum.org/en/execution-apis/#PR-318)
- Note: [EIP-4788](https://eips.ethereum.org/EIP-4788) may enable `transactions / withdrawals` proofs relative to CL state root

[ethereum/consensus-specs > PR #3078](https://ethereum.org/en/consensus-specs/#PR-3078)