JSONRPC Enhancement in Geth

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The Project proposal

The Project Proposal(background)

Currently:

- Use debug_traceXXX RPC to get the block traces
- While debug_traceXXX based on the historical statedb to replay the transactions
  - Slow performance
  - High CPU usage

The Project Proposal

Introduce a real-time tracing system, which will

- offer more efficient and prompt insights into the EVM execution
- support indexing the live execution data

How to index the live data

Workflow/Indexing

Support indexing:

- Traces: block number -> traces
- Nonce: (tx sender’s address + nonce) -> Tx Hash

Workflow/Data Schema

kvdb: used to store the newly created block traces and nonces

- A generic Key-Value Database(ethdb)
- Key Schema:
  - Traces: `*BlkNum || BlkHash || TraceType*`
  - Nonce: `Tx Sender's address || nonce`
- Value Schema: RLP encoded data

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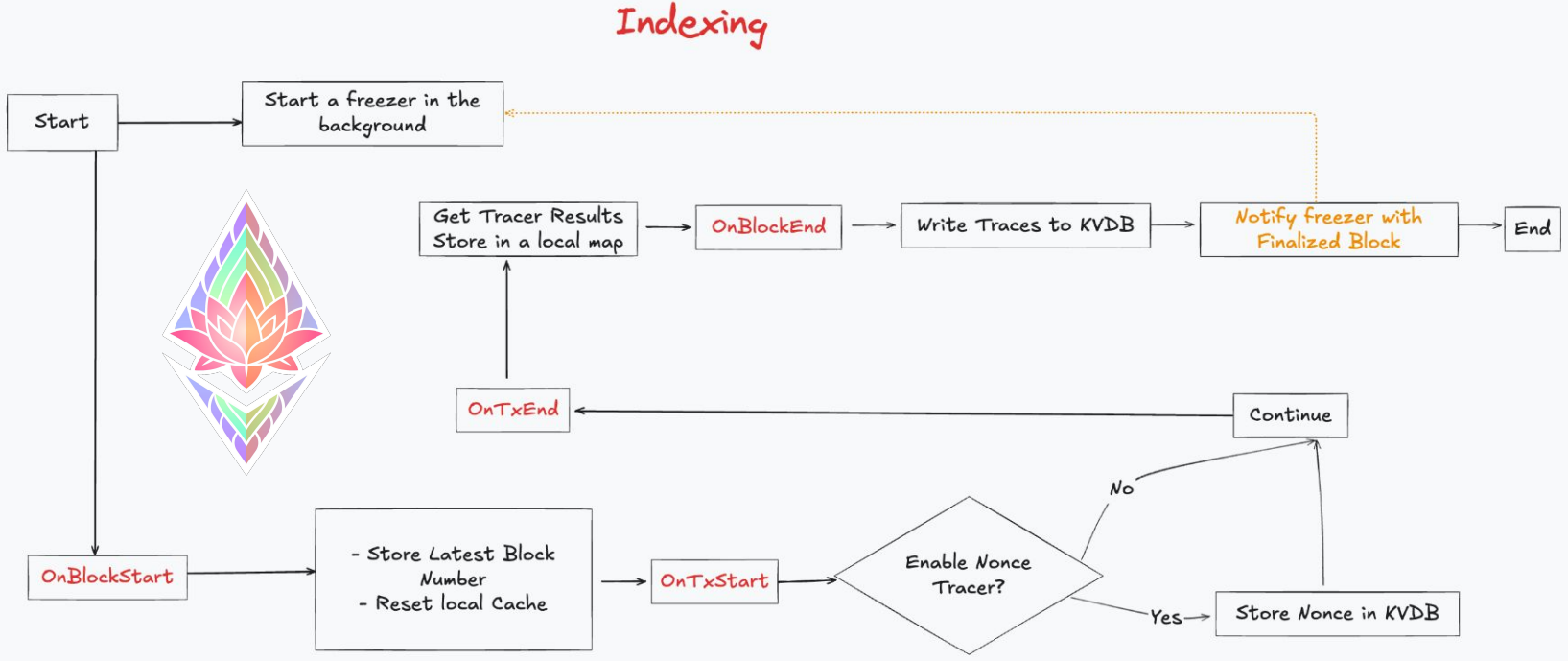
- TraceType is one of:
  - *callTracer*
  - *flatCallTracer*
  - *parityTracer*
  - *prestateTracer*

Workflow/indexing



How to retrieve the data

Workflow/Retrieving

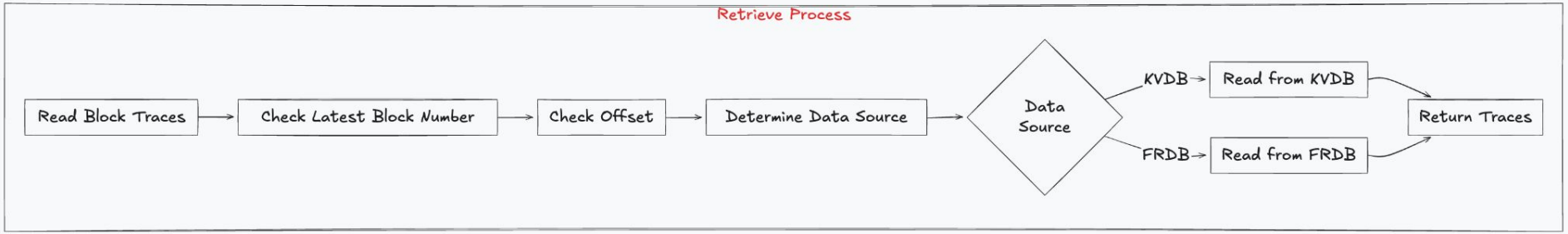
Traces:

- Retrieve by block number/hash
- Retrieve by transaction hash
  - Fetch block number by transaction first -> block number

Nonce:

- Retrieve by sender’s address + nonce

Workflow/Retrieving block traces



How to use this feature

How to use this feature/setup

Haven't merged yet, see #30255 for more detail

```
$ geth ... --http.api=...,trace \
  --vmtrace=live \
  --vmtrace.jsonconfig='{
      "path": "/data/live-trace",
      "enableNonceTracer": true,
      "maxKeepBlocks": 100000,
      "config": {
        "callTracer": { "withLog": true },
        "parityTracer": {},
        "prestateTracer": { "diffMode": true }
      }
}'
```

You need to enable the trace namespace either in http.api or ws.api

Configuration:

- path: a directory used to store the indexed data
- enableNonceTracer: weather or not to indexing the tx sender's tx-hash
- maxKeepBlocks: keep at most N blocks, older ones will be pruned periodly
- config: a map of each tracers you want to trace with, see builtin-tracers for more detail

How to use this feature/retrieve

Supported RPCs:

- trace_block
- trace_filter
- trace_transaction
- eth_getTransactionBySenderAndNonce

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- The trace_* RPCs are compatible with Parity's
- Besides of the Parity's call tracer, we can also retrieve other geth's native tracers' results.

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Eg: get the block(0x1)'s prestateTracer results

```
{
    "id": "1",
    "jsonrpc": "2.0",
    "method": "trace_block",
    "params": [
        "0x1",
        {"tracer": "prestateTracer"}
    ]
}
```

The performance

Space-Time trade-off

The performance between trace_ and debug_trace

Pro:

- No need to re-apply based on a state
- O(1) time complexity to retrieve the data
- Realtime retrieving

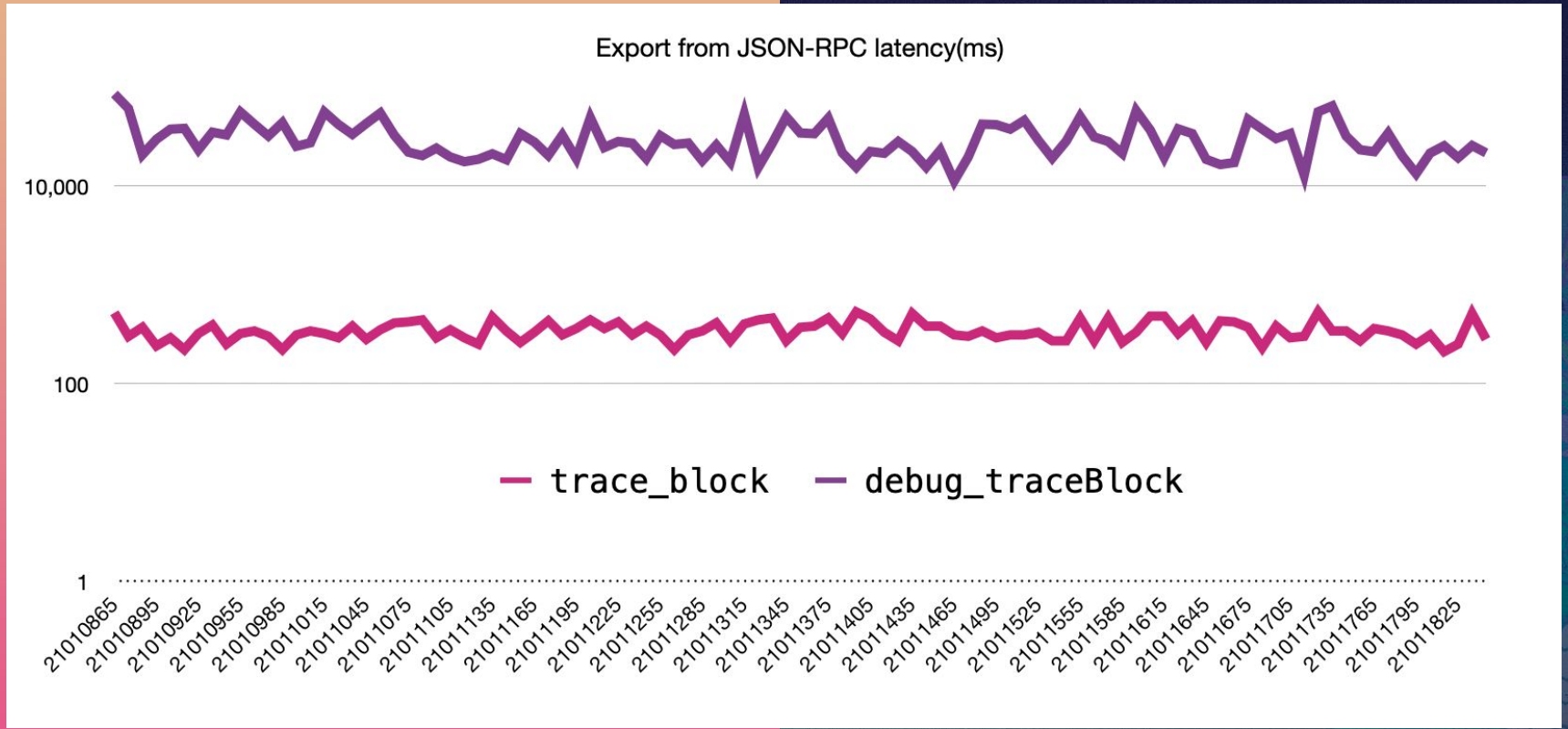
Con:

- Need extra disk space
- Little impact on the on-chain block syncing

Let’s compare the results

Use etl to dump traces from geth RPC into Postgres

```
$ ./etl dump2 \
    --chain=ethereum \
    --lag=64 \
    --start-block=21010865 \
    --end-block=21054092 \
    --period-seconds=60 \
    --max-workers=10 \
    --block-batch-size=10 \
    --batch-size=1 \
    ...
```


Export from JSON-RPC latency(ms)
10,000
100
1
trace_block
debug_traceBlock
21010865
21010895
21010925
21010955
21010985
21011015
21011045
21011075
21011105
21011135
21011165
21011195
21011225
21011255
21011285
21011315
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21011405
21011435
21011465
21011495
21011525
21011555
21011585
21011615
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21011765
21011795
21011825


Thank you!
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