

# RED QUEEN’S SYNC PROTOCOL FOR ETHEREUM

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ABSTRACT. TODO: abstract.

”A slow sort of country!” said the Queen. ”Now, here, you see, it takes all the running you can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!”

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Lewis Carroll, Through the Looking-Glass and What Alice Found There

## 1. INTRODUCTION

TODO: mention the sync failure problem Akhunov [2019a] and the needs of light clients like Mustekala. Inspirations like BitTorrent, Parity’s warp sync.

## 2. NOTATION

We mostly follow the conventions and notations of the Yellow Paper Wood [2018], for instance  $\mathbb{Y}$  denotes the set of nibble sequences. We use the letter  $\pi$ :  $\pi \in \mathbb{Y}$ ,  $||\pi|| \leq 64$  for prefixes of state or storage trie keys  $\mathbf{k} \in \mathbb{B}_{32}$ . A key matches a prefix iff all their first nibbles are the same,

$$\text{MATCH}(\mathbf{k}, \pi) \equiv \forall_{i < ||\pi||} : \mathbf{k}'[i] = \pi[i]$$

( $\mathbf{k}'$  is a sequence of nibbles, while  $\mathbf{k}$  is a sequence of bytes.)

## 3. PROTOCOL SPECIFICATION

TODO: check geth’s fast sync spec.

## 4. SUGGESTED FULL SYNC ALGORITHM

TODO: top-level trie with branch nodes only that track blocks; phase 1, phase 2.

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## 5. PERFORMANCE ANALYSIS

For this analysis we assume that all tries are well balanced. We also assume that all top nodes up to a certain trie depth  $d$  are branch nodes, not leaf or extension ones. This is a reasonable assumption if  $d$  is not too big—see Akhunov [2019b].

TODO: optimal phase 1 depth.

Let us further assume that all leaf changes are random and independent of each other. TODO: optimal phase 2 depth.

## 6. CONCLUSION

TODO: conclusion.

## REFERENCES

- Alexey Akhunov. Looking back at the Ethereum 1x workshop 26–28.01.2019 (part 1), January 2019a. URL <https://medium.com/@akhounov/looking-back-at-the-ethereum-1x-workshop-26-28-01-2019-part-1-70c1ebd93266>.
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- Gavin Wood. Ethereum: A Secure Decentralised Generalised Transaction Ledger, December 2018. URL <https://github.com/ethereum/yellowpaper>.