Performance Analysis Of Blockchain Networks In A Healthcare Context

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Abstract. *The purpose of this work is to analyze the performance of two different blockchain networks in the context of healthcare applications. Blockchain networks are known for their decentralized structure, resiliency, and tamper-proofness. Hyperledger Fabric and Ethereum were used to benchmark and compare its performance in two scenarios for a simple blockchain smart contract that stores patient image data. The results showed a slight advantage for Ethereum in increased load tests and it also obtained a lower degree of variation during these tests.*

1. Introduction

Blockchain is a decentralized, read-only ledger that securely adds blocks via consensus [Tabatabaei et al. 2023], but faces adoption hurdles like scalability, energy use, and latency [Monrat et al. 2019].

The medical sector can benefit from such a network by allowing patients to manage access to their data and share it securely with professionals and laboratories. This includes medical formats such as X-Ray and CT-Scan images. Blockchain offers privacy and scalability in decentralized healthcare systems [Thakkar et al. 2018], although handling large volumes of data can present performance challenges.

In this work, we compared the performance of private blockchain Hyperledger Fabric and an Ethereum simulated network Ganache with healthcare image data as input and measured the following metrics: throughput, latency, CPU and RAM usage of both networks using Hyperledger Caliper as a benchmark tool.

2. Methods and Materials

Smart contracts were implemented in Solidity (Ethereum) and Go (Hyperledger Fabric), both with store and retrieve functions. Store function receives a hash, created with a local api using user name and cpf, and a permalink representing the user's image address on a remote server. Code is available at: [https://github.com/suzanaporto/eradne2025].

Both networks were deployed using a desktop computer with 16 GB of RAM and a 12th Gen Intel(R) Core(TM) i7-12700H 2.70 GHz processor. The Hyperledger Fabric blockchain was deployed with 2 peers, 1 orderer, and 1 channel. Ethereum was set up using a gas limit of 8500000 ETH and a hard-coded mnemonic. Benchmark tests were performed with Hyperledger Caliper with two types of tests, with 2 rounds each: A stress test (increasing transaction loads) and an endurance test (sustained transactions over time).

3. Results

After performing both stress and endurance tests, the results show analysis of resource consumption, combined with latency and throughput measurements.

Figure 1 shows the outcome of the stress test. Two rounds were performed with a linear progressive increase in transactions on the blockchain, one up to 50 transactions, and the other up to 100.

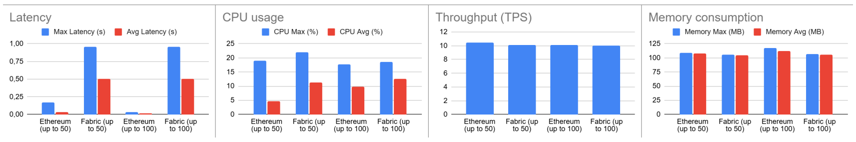

Figure 1. Stress test results, with rounds up to 50 and 100 transactions

Figure 2 shows the performance of both networks during the endurance test, which consisted of fixed amounts of transactions (10 and 20 tps) over a 60-second period.

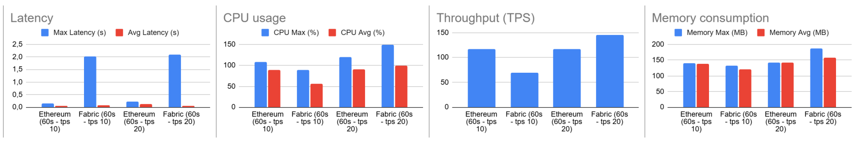

Figure 2. Endurance test results, considering rounds of 60 seconds

Ethereum performed better overall in the stress test, averaging above Fabric in all metrics except memory consumption. The endurance test had mixed results, with Ethereum performing better in the 100 tps load test, on average, in latency and throughput and Fabric performing better on these same higher loads in memory and CPU usage.

4. Conclusion and Perspectives

Considered measures show a slight performance advantage of Ethereum over Fabric in increased workloads, and also obtained less variation during testing. Considering that simulated networks were used, the results might differ when using real production blockchains. Robust benchmark methodology is considered for future work.

References

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