Performance Comparison of IoT Based Metering System with Different Blockchain Platforms

Chathura Edirimanna
Department of Computing and Information System
Sabaragamuwa University of Sri Lanka
Belihiloya, Sri Lanka
emcrawisankha@std.appsc.sab.ac.lk

Pubudu Jayasena
Department of Computing and Information System
Sabaragamuwa University of Sri Lanka
Belihiloya, Sri Lanka
pubudu@appsc.sab.ac.lk

***Abstract* — Blockchain technologies are rapidly adopted worldwide. Internet of Things and blockchain adaptation can give better performance and security for users. Blockchain technologies still there is a strong lack of framework that tests and contrasts various schemes. This framework can be used to evaluate the potential of blockchains and making it easier for developers to find bottlenecks and therefore improve their applications. This paper includes performance analysis of a two blockchain platforms. Consider Ethereum and Hyperledger Fabric to estimate the performance and limitation of these platforms. For this evaluation chose use case as an electricity billing scenario. Measure the platform's performance and quality. For that use Hyperledger caliper performance benckmark tool. It compares various systems and makes it possible to better understand the different application options by measurement analysis in terms of throughput, latency, protection and fault tolerance. Finally evaluate and pick the right billing scenario blockchain framework.**

Keywords — blockchain, internet of things, ethereum

I. INTRODUCTION

Significant progress of blockchain both in variations and quantities has been seen in the past few years. Although well-established blockchain systems have now been implemented to address the demands of these new technologies, there is still a want for more autonomous and hands on success testing of these blockchain technology. For experts to identify margins and decide which platform to accept for their own applications, this knowledge will be essential [3]. The focus here is a performance analysis of a few blockchain platforms for electricity use cases. Throughput and latency are among the key technological difficulties and limitations which have not been commonly studied.

Distributor-consumer transactions are far from automation and Current utility payment systems and delivery systems lack accountability. In most implementations, current usage rates cannot be tracked, because most metering schemes still rely on manual meter readings. This metering method often costs a great deal of time and money [1]. A program is required in which all users meet the same rates of usage, all consumers have trust in the system and personal data privacy is secured. Consumption patterns should be calculated and used to address technical challenges before any future challenge is critical. Blockchain and IoT may be used as a workaround [2]. Applying smart contracts based on blockchain offers a chance to increase the speed, scale and safety of energy applications. This advancement provides the best blockchain network for the electricity billing system.

The reason of using blockchain in the energy sector is gaining a more and more huge interest. Decision-makers and utility businesses in the energy sector have asserted that blockchains can potentially offer solutions to energy industry challenges [4]. Blockchain technologies have the potential to enhance energy and process efficiency, accelerate IoT platform development and digital applications and innovate the P2P energy trading and decentralized generation. Moreover, blockchain technologies have the potential to improve current energy companies and utilities practices considerably by improving internal processes, customer services and costs.

Blockchain technologies can be added to a several of use cases associated to the operations and business practices of energy firms.

It provide, billing mechanism, sales and marketing, trading and markets, automation, smart grid applications and data transfer, security and identity management, sharing of resources, competition and transparency to energy sector rather than current mechanism.

II. OBJETIVES

This work maingly focus on evaluate performance of ethereum and hyperledger fabric blockchain platforms for electricity billing scenario. In addition,

- To build different blockchain platforms for smart metering scenarios.
- To measure performance choosen blockchain platforms.
- To choose the best blockchain platform for electricity metering systems.
- To improve the scalability of the electricity industry by using the best platform, Increase customer experience, and increase blockchain understanding.
- Provide trust by blockchain agreement (consensus) for the entire electric network.

III. METHODOLOGY

Figure 1 describe overall flow diagram of the expected system for performance evaluation. Analyze and calculate the real electricity usage data to performance evaluation for ethereum and hyperledger fabric platforms. First get meter reading using current sensor and send that data to the hosted server. Then create blockchain implementation with smart contracts for both ethereum and hyperledger fabric blockchain platforms that can enable pay users electricity usage. Next configure hyperledger caliper for both platforms and measure the performance with real electricity usage data.

Finally compare two platform and find best platform for billing scenario.

Methodology has main three processes.

1. Hardware setup

ISSN 2756-9160 / November 2020.
International Conference on Advances in Computing and Technology (ICACT–2020) Proceedings

A Current sensor has been selected by the project to monitor and store improvements to the user interface of the power meter. This current sensor (HW-670) is the instrument that detects and transforms current through the measured path to the comfortable, current-related output voltage. When a current travel through a wire or a circuit, a voltage saving occurs.

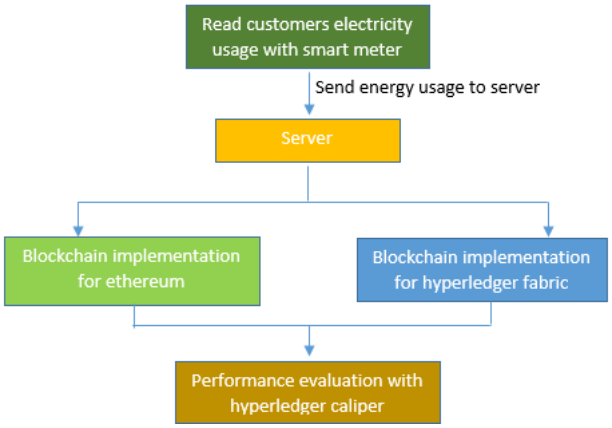

Fig. 2. Overall flow diagram

2. Blockchain implementation

The virtual machine Ethereum (EVM) is a virtual network for the execution of intelligent contracts. The benefit of using an EVM is that no infrastructure is required and that the entire blockchain network can be set up in similar settings. EVM is the JAVASCRIPT VM environment for any Ethereum node which provides a complete validation for any mission carried out in EVM with https:/remix.ethereum.org. Then the nodes conduct logical contracts. Developed smart contract algorithm is shown in below.

mapping (address => uint256) **balance**
Init: address
constructor (Tokens, new customer):
Customer = new customer
balance[Customer] = Supplier

Event Transfer(Sender, amount, Receiver);
Function pay(Sender, Amount):
if balance[Sender] ¿ Amount then **then**
balance[Sender] += Amount
balance[Customer] -= Amount
return
else
return FALSE
end if
Function (getBalance(Sender):
return balance[Sender]

3. Performance evaluation

hyperledger caliper - Benchmarking tool for blockchains used to estimate the performance of individual blockchain applications is the hyperledger caliper supplied by the Hyperledger project. The key aim of Caliper is to help developer's find the best blockchain platform, measure resource consumptions and quantify network costs. The parameters endorsed are performance rate, transaction phase, latency and consumption of resources (CPUs, memory).

Metrics - Following has been described what are the metrics utilized in the analysis and gathering of the data.

Transaction Latency measures from the point a transaction is given in to the point the result is available throughout the network. Does include the propagation time and the consensus processing time.

Transaction Throughput checks the number of lawful transactions committed in the Blockchain network. The rate estimation takes place in all nodes as transactions per second (TPS).

Sending Rate is the real sending rate on the Target TPS of the Hyperledger Caliper. The exact number set in the configuration file will be attempted by Caliper.

Successful transaction indicates the number of transactions committed to the ledger. The causes include a number of network glitches, time-outs, caliper glitches and the lack of a packet, to name a few.

CPU displays the CPU power used for the containers for research. Measured in Caliper in the form of CPUs (MAX) and CPUs (AVG).

IV. RESULTS AND DISCUSSION

Hardware setup: Read users electricity reading using HW-670 current sensor. And send that reading to hosted server. For that used 000webhost server and following figure 2 shows electricity reading results database.

Performance evaluation: Both ethereum smart contacts and hyperledger fabric chain codes are validated. Then measured performance ethereum platform with smart contracts and Hyperledger fabric with chain code. Figure 3, 4 respectively show both platforms caliper reports.

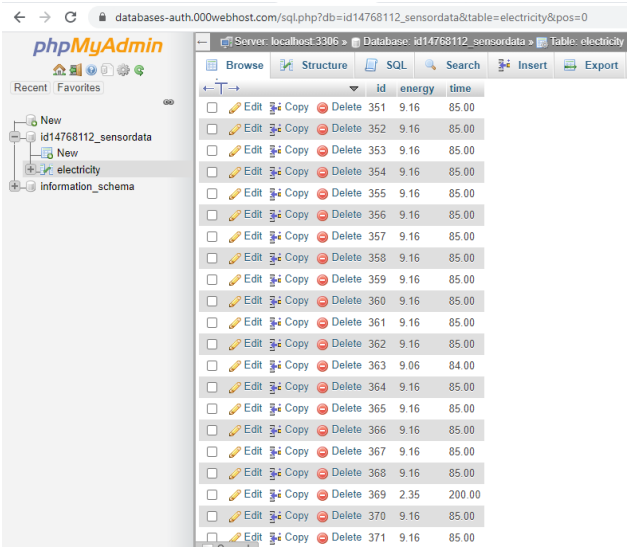

Fig. 3. Meter reading database

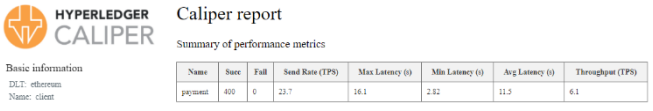

Fig. 3. Caliper report for ethereum

ISSN 2756-9160 / November 2020.
International Conference on Advances in Computing and Technology (ICACT–2020) Proceedings

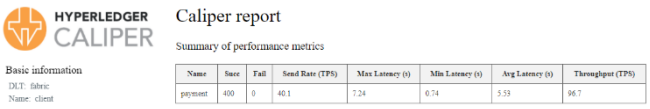

Fig. 4. Caliper report for Hyperledger Fabric

Comparison of ethereum and hyperledger fabric implementations: Table 1 described performance metrics evaluations for both blockchain platforms. It shows best performance in hyperledger fabric blockchain platform.

Table 3 Performance Comparison

	Ethereum	Hyperledger Fabric
Blockchain type	Public Permission-less	Permissioned
Throughput	6	96.7
Consensus Mechanism	Proof of work	PBFT
Blockchain generation time	15 seconds	0.26 seconds
Programming	Solidity	Chaincode

Blockchain's dominance in the electricity and bill payment fields is not only apparent but inevitable. In the energy market, the blockchain and its implementation case is still under progress and not without shortcomings. There are also areas that needed to be upgraded and excavated. The methods suggested include contextual analysis for the application of ethereum and hyperledger fabrics. Users can see the Hyperledger Fabric is lightweight and adjustable.

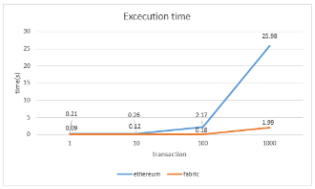

Fig. 5. Execution time with transaction

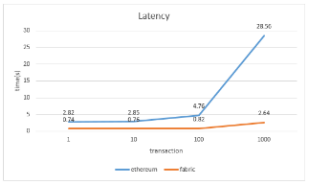

Fig. 6. Latency with transaction

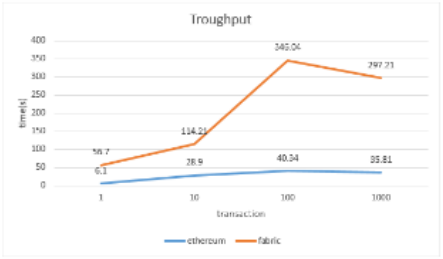

Fig. 7. Throughput with transaction

Respectively figure 5, 6, 7 show how to change execution time, latency, throughput according to amount of transactions. Execution time and latency were increased according to amount of transactions ethereum rather than hyperledger fabric. Throughput was increased according to amount of transaction increase hyperledger fabric rather than ethereum. Analysis of this performance comparison hyperledger fabric blockchain platform is most suitable for electricity billing scenario.

V. CONCLUSION

This research focuses on the performance analysis of electricity billing systems. This can extend for various blockchain platforms. Then test blockchain efficiency for selected platforms using Hyperledger Caliper tool. After this, determine the most appropriate electricity billing platform for the blockchain. Hope to check transaction sending rate, batch size, and output, usage of the CPU/memory and latency. Hyperledger Caliper presented details on the output of the proposed model with the benchmarking tool, which can serve as a basis for future discussion. Latency, Processing and memory bottlenecks were found. This study not only builds a leap forward in rigorous reliability measures, but also outlines the ways in which the Caliper instrument should only be used for energy billing. Further hope that success with other blockchain systems will also be assessed. The aim is to in future test potential solutions for the bottlenecks using various consensus algorithms, different endorsers, various databases and more powerful hardware. And this can also refer to multiple implementation scenarios.

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