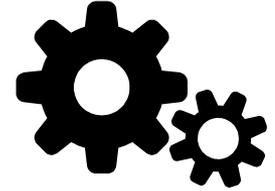


Blockchain for Education



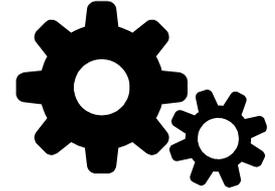
Suporn Pongnumkul, Ph.D.

National Electronics and Computer **TE**chnology **C**enter (**NECTEC**)
THAILAND



Our Journey





Our Journey



Understand & Compare

Hyperledger Fabric **Vs.** Ethereum

Analysis and Comparison of Blockchain 2 Platforms

1.



ICCCN is one of the leading international conferences for presenting novel ideas and fundamental advances in the fields of computer communications and networks. ICCCN serves to foster communication among researchers and practitioners, and applications of computer communications and networks.

Presented at ICCN 2017

tion, and applications of computer communications and networks.

Performance Analysis of Private Blockchain Platforms in Varying Workloads

Supen Pongnumkul, Chaiyaphum Sirirapapornchasa, and Suttipong Thajichayapong
 National Electronics and Computer Technology Center, Thailand
 Email: supen.pongnumkul@nectec.or.th

Abstract—This paper conducts a performance analysis of two popular private blockchain platforms, Hyperledger Fabric and Ethereum (private deployment), to assess the performance and limitations of these state-of-the-art platforms. Blockchain, a decentralized transaction and data management technology, is said to be the technology that will have similar impacts on the Internet had on people's lives. Many industries have become interested in adopting blockchain in their IT systems, but scalability is an often-cited concern of current blockchain technology. Therefore, the main of this preliminary performance analysis are twofold. First, a methodology for evaluating a blockchain platform is developed. Second, the analysis results are presented to inform practitioners in making decisions regarding adoption of blockchain technology in their IT systems. The experimental results, based on varying number of transactions, show that Hyperledger Fabric consistently outperforms Ethereum across all evaluation metrics such as execution time, latency and throughput. Additionally, both platforms are still not compatible with current database systems in terms of performance in high workload scenarios.

1. INTRODUCTION

Recent years have seen significant growth of blockchain applications both in variations and quantities. Even though well-established blockchain platforms have already been adopted to meet demands of these new applications, more independent and hands-on assessment of performance of these blockchain platforms are still necessary. These information would be essential for practitioners to understand limitations and design in which platform to adopt for their own applications.

The focus on this paper is on performance analysis of private blockchain platforms. Even though blockchain was first introduced in its world as the technology behind Bitcoin, some characteristics of the Bitcoin blockchain themselves are unsuitable for certain business applications. In this respect, private blockchain concept is introduced to allow business to use blockchain technology. Unlike in the Bitcoin blockchain, only the companies which are granted permissions can participate in private blockchain network. Transactions are also processed at a much faster rate compared to Bitcoin's ten minutes per block.

There are still many challenges that lie ahead for adoption of private blockchain platforms. A recent pre-publication paper explores the performance of private blockchain platforms [1] and cited performance evaluation as a research opportunity. Performance is one of the biggest concerns in adopting blockchain platforms as it is necessary to provide a viable alternative to existing financial platforms. Some surveys, such

as Bitstars [2], are specifically exploring approaches to address this limitation.

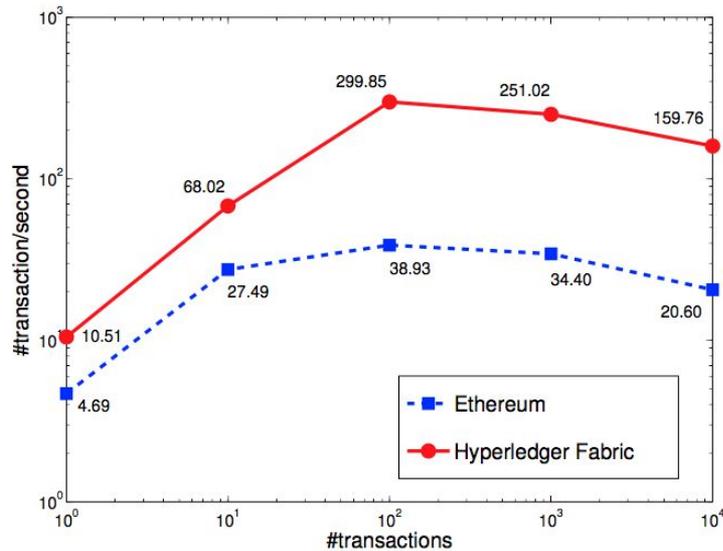
An extensive review on research topics on blockchain in a decentralized transaction and data management technology, is said to be the technology that will have similar impacts on the Internet had on people's lives. Many industries have become interested in adopting blockchain in their IT systems, but scalability is an often-cited concern of current blockchain technology. Therefore, the main of this preliminary performance analysis are twofold. First, a methodology for evaluating a blockchain platform is developed. Second, the analysis results are presented to inform practitioners in making decisions regarding adoption of blockchain technology in their IT systems. The experimental results, based on varying number of transactions, show that Hyperledger Fabric consistently outperforms Ethereum across all evaluation metrics such as execution time, latency and throughput. Additionally, both platforms are still not compatible with current database systems in terms of performance in high workload scenarios.

Even though throughput and latency of well-known blockchain platforms have previously been quantified, the scenarios when transactions are made by large number of users have not yet been explicitly assessed. Earlier studies often use Bitcoin as a study case for insight analysis such as the relationship between propagation delay and blockchain forks [3]. A more recent study in [4] focuses more blockchain's throughput and latency where the adjustment of block sizes and intervals are proposed as a first step. Recently, a more generic framework has been proposed in [1], where the results on throughput and latency presented in [1] are assessed mainly by varying number of nodes.

In this paper, the analysis is focused on varying number of transactions, which is expected to complement the findings in [1]. The contributions of this paper are summarized as follows. First, a repeatable methodology for evaluating a blockchain platform is presented. This performance evaluation methodology is used to assess the current states of Hyperledger Fabric and Ethereum are presented, where both blockchain platforms are assessed in respect to throughput and latency with up to 10,000 transactions. Second, results from assessing those blockchain platforms and their implications are discussed, which practitioners can take into consideration when adopting for their own applications. We also note that as consensus protocols are found to induce bottlenecks in [1], they are not taken into account in this analysis.

This paper is organized as follows. Section II provides a brief overview of the target blockchain platforms in this analysis. In Section III, the methodology for assessing blockchain platforms is presented. Then, results and their implications are discussed in Section IV. Finally, Section V concludes this paper.

Throughput of Hyperledger Fabric Vs. Ethereum



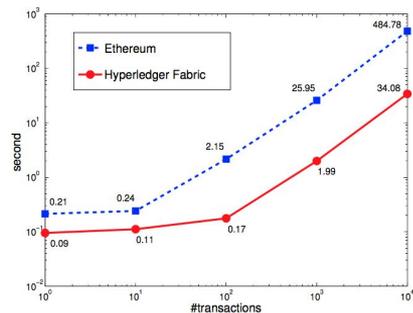
Results

* Hyperledger Fabric can process 300

transactions per seconds

* Ethereum can process 39 transactions per seconds

Latency of Hyperledger Fabric Vs. Ethereum

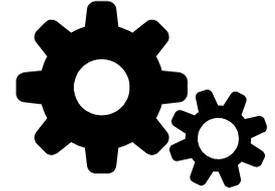


Results

For large number (10,000) of transactions

* Hyperledger Fabric's average latency is 34 seconds.

* Ethereum's average latency is 485 seconds



Our Journey



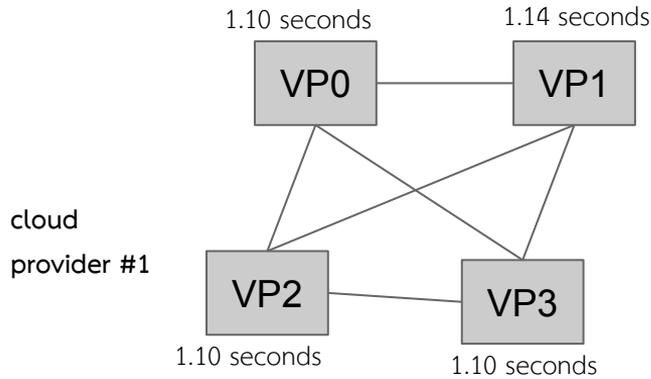
2.

Deep Dive into **Hyperledger Fabric**

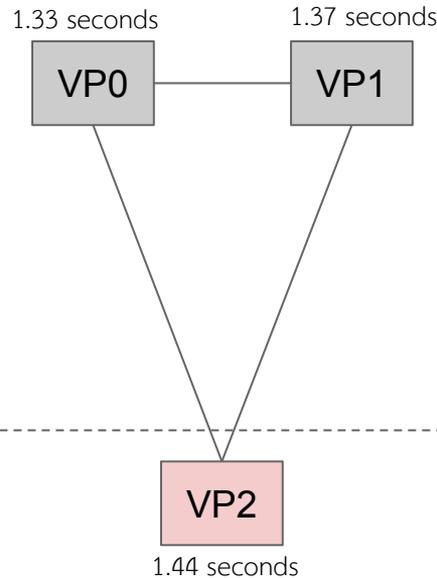
Data propagation of **Hyperledger Fabric**

How data propagate under different network setups

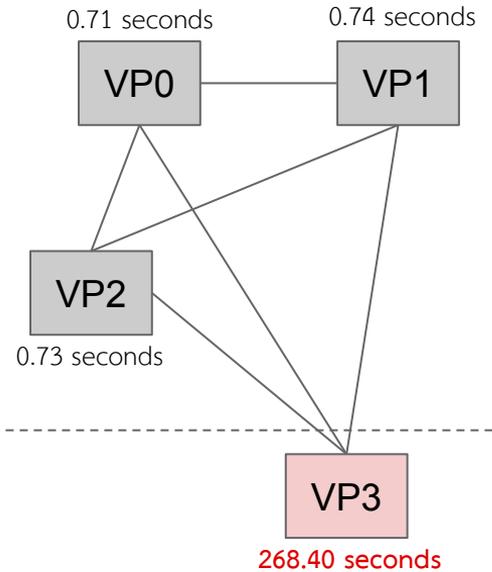
Setup 1

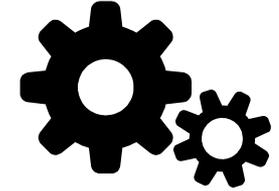


Setup 2



Setup 3





Our Journey



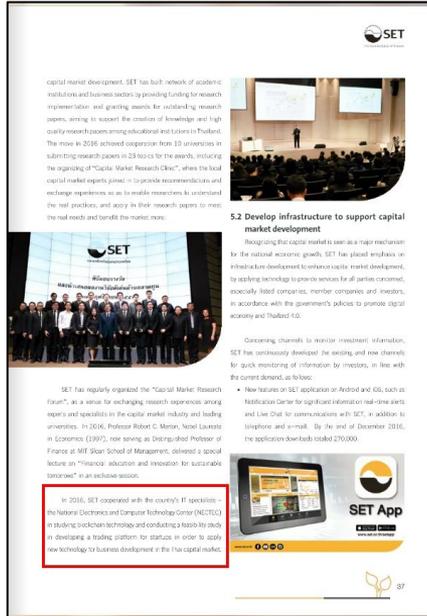
3.

Partner

to develop Blockchain applications

Using Hyperledger Fabric

FinTech Partners

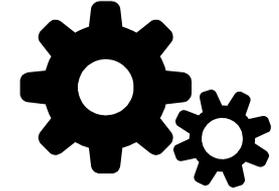


<https://www.set.or.th/en/about/annual/2016/index.html#39>

Assessment of capabilities and limitations of blockchain platform for developing a stock market with **SET**



Evaluation of solution designs of E-LG on blockchain for 14 Thai banks with **KBTG**



Our Journey



4.

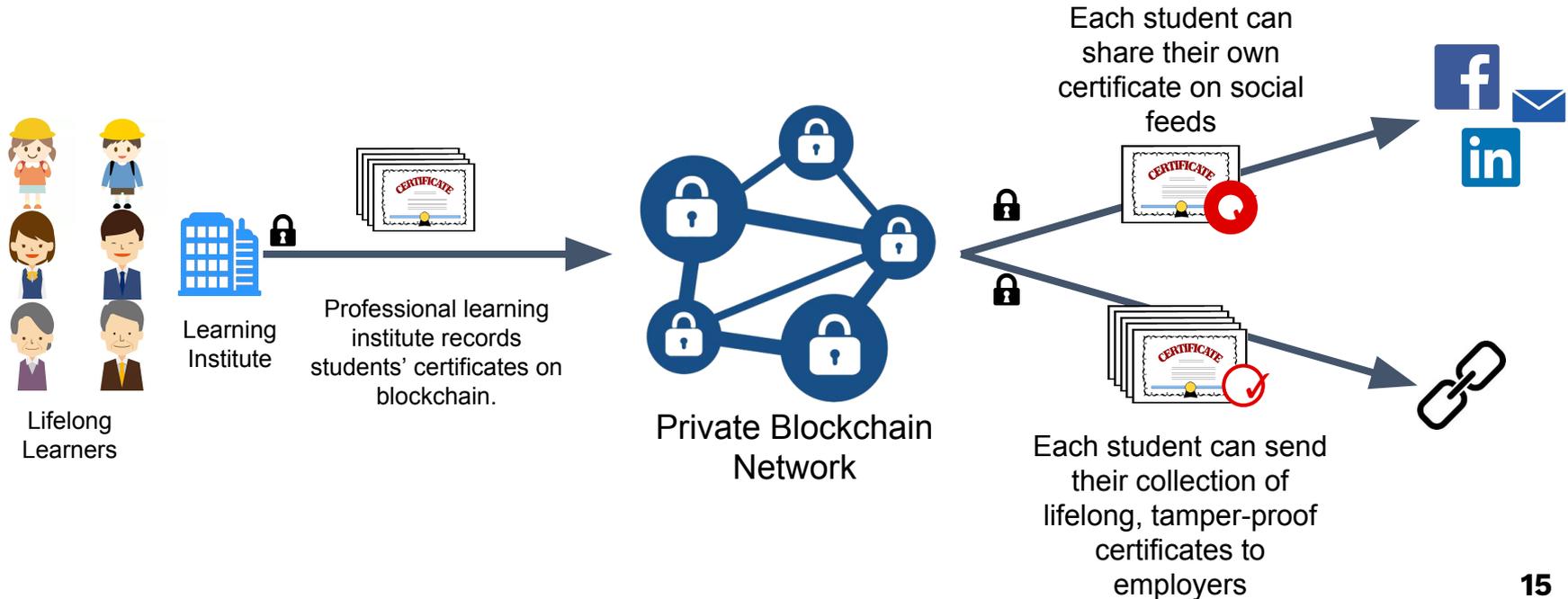
Build an application
to record **Education Certificates**

Under Hyperledger Fabric 1.0

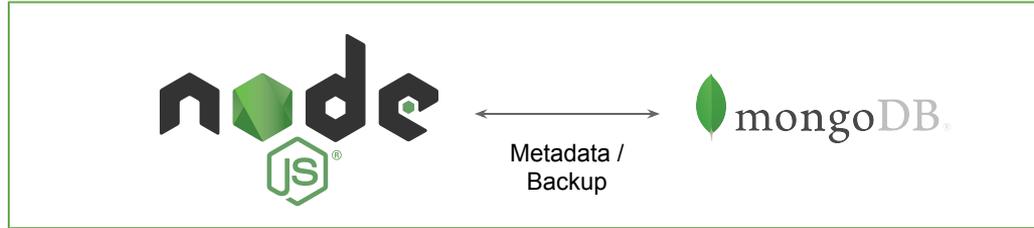
Problem with current approach

- Losses of paper certificates
- Frauds in education certificates
- Difficulty in verifying authenticity
- Disconnected lifelong learning records

Proposed Blockchain Solution



Application Architecture



Web Application call a REST API generated by the Composer REST Server

Hyperledger Composer Components



Use ID cards to connect to a distributed ledger.



Hyperledger Fabric 1.0

Benefits

Professional Learning Institutes

- Record certificates securely on blockchain
- Look trustworthy!

Students

- Have verifiable certificates
- Keep all records in one place for life

Employers

- Verify certificates of applicants and employees easily

Why am I here?

If you are interested in partnering
to build a blockchain for education,

LET'S TALK!

Thanks!



Suporn Pongnumkul, Ph.D
suporn.pongnumkul@nectec.or.th