A Report on Qualitatively and Quantitatively Comparing Typical Cross-chain Technologies Implemented by the Relays Pattern

I. Introduction

This report conducted a qualitative and quantitative comparison on two typical cross-chain technologies implemented by the relays pattern, Cosmos and BitXHub. In terms of qualitative comparison, we gathered the data of these two technologies from their official project websites, project white paper, existing literature, or grey literature. Then we compare the projects from some aspects that may impact the performance, such as verification mechanism and consensus algorithm. In terms of quantitative comparison, we conducted a preliminary experiment under the control of the rest environment variables, in which network consensus time, throughput, and response time of the two projects were compared respectively. Consensus time is the time of Cosmos network executing the consensus. Response time is the time that transactions get through the entire relay network. Throughput is the number of valid transactions per second processed by the relay chain.

When conducting the experiment, we make both of the Cosmos network and the BitXHub network consisting of 4 nodes and keep them the same topography. Then we limited the block size to 500 transactions and set the interval of block to 0.5 seconds. All nodes run on the x86_64 remote server with Linux operating system which version is Ubuntu-18.04-Desktop. We used IPv4 as the network protocol and allocated 4 vCPUs and 8GB memory in each round of testing. Every node in our testing network is a separate Docker container, and the version of Docker is 19.03.12.

The software environments of BitXHub and Cosmos are shown in the Table I and Table II.

TABLE I: Software Environment of BitXHub

Environment	Name	Version number
Blockchain Network	Hyperledger fabric	1.4.3
	Ethereum	1.0.0
Go_env	Golang	1.13.4
Cross-chain platform	BitXHub	v1.0.0-master-2bb82e8
BitXHub performance testing tool	Premo	v1.0.0-master-07508b5
Docker images	hyperledger/fabric-tools	1.4.3
	hyperledger/fabric-ca	1.4.3
	hyperledger/fabric-ccenv	1.4.3
	hyperledger/fabric-orderer	1.4.3
	hyperledger/fabric-peer	1.4.3
	hyperledger/fabric-baseos	amd64-0.4.15
	meshplus/ethereum	1.0.0

TABLE II: Software Environment of Cosmos

environment	name	version number
Blockchain Network	tendermint	0.34
Go_env	Golang	1.15.6
Cross-chain platform	Cosmos (Gaia)	2.0.0
Tendermint performance testing tool	Tm-load-test	0.9.0
Docker images	Tendermint	0.34

II. Results

A. Qualitative comparison

From the qualitative comparison of Cosmos and BitXhub, we find that these two projects have their own design and implementation. Cosmos is based on PBFT to ensure distributed consistency and can realize remote synchronization to ensure network scalability. The consensus algorithm of Cosmos has a high degree of complexity in verification time and there is a trend of centralization of the cross-chain network, which may negatively impact the performance. RAFT protocol used by BitXhub, has low block interval and high throughput and it may be more efficient when dealing with a relatively large number of transactions[1].

B. Quantitative comparison

The quantitative comparison of the consensus time, the response time and the throughput of the two cross-chain technology relay systems are shown in Fig. 1, Fig. 2, and Fig. 3. The results to some extent demonstrates the advantages of BitXHub in terms of performance.

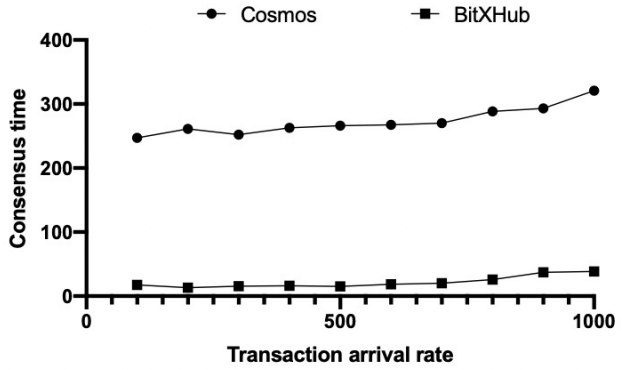

Fig. 1: Comparison of consensus time.

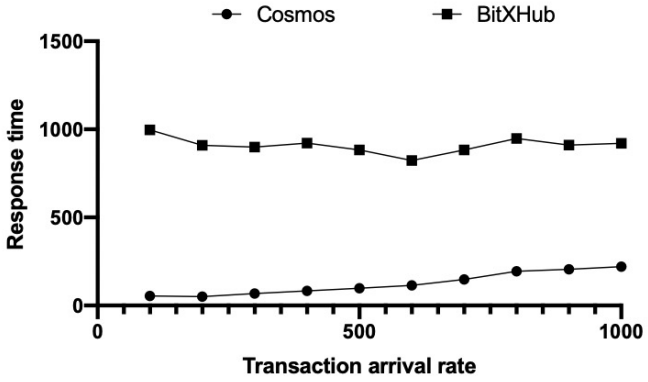

Fig. 2: Comparison of response time.

2

3

[1]Huang, Dongyan, Xiaoli Ma, and Shengli Zhang. "Performance analysis of the raft consensus algorithm for private blockchains." IEEE Transactions on Systems, Man, and Cybernetics: Systems 50.1 (2019): 172-181.

[2]https://github.com/meshplus/bitxhub

[3]https://github.com/tendermint/tendermint

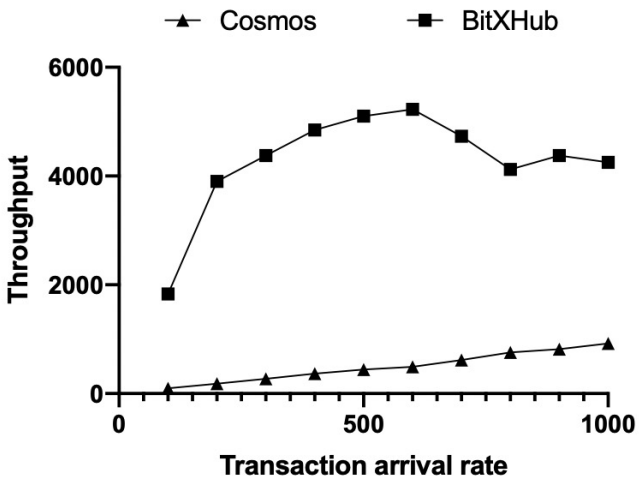

Fig. 3: Comparison of throughput.