Performance Analysis of Multiple Networks of Blockchain with Varying Transaction

[1]Harris Iftikhar, [2]Hamza Aslam, [3]Sharjeel khan

[1]Punjab University College of Information Technology, Lahore

[2,3]Gift University, Gujranwala

Abstract: - Now-a-days blockchain is becoming the main trend which provides distributed applications without involving the third party. It also provides security to their users so here are numerous business enterprises that want to adopt blockchain in their IT systems. This paper conducts the performance analysis of multiple networks of blockchain, public and private permissioned and permissionless networks, to evaluate the performance and boundary of these platforms with changing the numbers of transactions. The main objectives of this primer investigation are twofold. Initial, a technique for assessing a blockchain platform is deployed. Second, the results from this study are introduced to educate experts in settling on choices with respect to selection of blockchain innovation in their IT frameworks. For performing analysis, multiple research works are involved and after this point we can say that the number of transactions not only affect the performance of blockchain networks but also some other factors are involved in it. This paper introduced these factors, caching, hardware setup, allocation of resources, RAM, the implementation of stack.

Keywords: - Blockchain, Blockchain Networks, Frameworks in blockchain, Improvement in blockchain, Performance, Optimization in performance, Throughput, Performance, Number of transactions.

I Introduction

Blockchain innovation is the current fundamental pattern is to give distributed applications without utilizing a confided mediator, while encountering security essentials, for example, respectability, legitimacy, non-disavowal, and obligation regarding storing information [1]. Blockchain performance is the rate at which any transaction takes place and get the result back. A cryptocurrency sends the transaction, after that give a call to a smart contract. A transaction gets ready and then we transfer it to the respected framework and then wait for the outcome. Actually, it shows that factor which is the time when a user gets a verification of its payment that is accepted, committed contracts. There are some parameters that affect the performance in blockchain like no. of transaction, no. of nodes, throughput, latency, configurations and setting of hardware, scalability, framework structure of blockchain and operations that are performed by the smart contract etc. Public and private frameworks also affect the performance in blockchain. [1][4][10] In this paper we will define the association between transaction and performance in both public and private frameworks of blockchain.

A transaction is a brand-new report of change of a few values or information among public addresses of the blockchain. Transaction process: The trademark of the client is the main quality of a transaction in blockchain that is included to accommodate the transaction. So, when a user joins the network, they receive an asymmetric key to interact with the blockchain and the user can only be identified by this key. Users can sign the transaction by using their private key. The purpose of this signature is to make sure the non-cancellation of transaction and also validation of the authenticity of content. Users can transmit the transaction to their adjacent node after signing the transaction.[10] The client/client communicates the exchange to different givers. Each benefactor sends the exchange in a sandbox and registers the looking at read make set close by the variation number of each key that was gotten to. Each donor also uses business rules to support the exactness of the trade. The client holds on for a satisfactory number of supports and subsequently sends these answers to the orderers, which execute the mentioning framework. The orderers

initially go to an arrangement about the solicitation for moving toward exchanges and a short time later piece the message line into blocks. Blocks are passed on to peers, who by then endorse
and submit them. [3] Transaction has some configurations in blockchain. The quantity of transaction produced in each round is the transaction number (TX Number). The transaction rate during the test measuring sub-rounds is transaction rate (rate Control). Transaction type has two options, that are "open and query". When in 1 transaction only one read and write activity is execute, we will say that it is "open" transaction, when a read operation is executed by the transaction from CouchDB it will "query" transaction.[4] Components of transaction are Authentication; Authorization; Proof of work; Proof of Stake.

2 Literature Review

Most of the researchers have work on machine learning [12-16, 18-22, 25-29, 33-39] approaches like Fuzzy Inference System (FIS) [11, 17, 23], Convolutional Neural Network (CNN) [24], and computational approaches [30-32] as well. There are multiple frameworks in blockchain: public permissioned and permissionless networks, and private permissioned and permissionless networks. In all types of networks, performance can be different under the same environments. Some factors involved in evaluating performance are no. of transaction, no. of nodes, throughput, latency, configurations and setting of hardware, scalability, framework structure of blockchain and operations that are performed by the smart contract etc. There are some research papers that discuss the effects of Throughput, Latency and Scalability on performance in these networks. [4] Every framework has a different structure, and they deal with transactions in different ways. In this paper we will do SLR of some research papers and observe the relationship between number of transactions and performance in multiple platforms of blockchain. During the research some research papers show results that the gap between the execution time grows larger as the number of transactions grows. [1] The paper analyses the effect of the workload of the network on performance. The network workload relates to changing the number, rate and type of transactions.
Public network is the major platform in blockchain where anyone from anywhere can easily work by downloading the software and running it to their own computer as a private network. The main reason behind it is that the user can get a digital currency. [1] The private blockchain shows significant implementation as a IOT security framework as well as credit management etc. Blockchain is now used as a service by many cloud applications like AWS, Oracle, IBM etc. [9] where users can set up the blockchain platform and run smart contracts very easily and quickly.

3 Research Gap

This analysis is helpful for the future researchers who want to do SLR on performance with multiple transactions. They can perform transactions in the networks to analyses them relatively. Add the other networks and extend the test cases with different test environments that permit the implementation of other private and permissioned blockchain networks.

4 Methodology

Public permissionless and permissioned networks: Consensus mechanisms in public permissionless networks need to be very strict as the trust level between the users is less. The equivalence between the nodes is primary and important property of any public network. In consensus mechanism we can say that the miner can be any node when a user receives its key of cryptography for signing and performing transactions. So, in this network main issue is a co-operative environment and here we have information which can be seen by all user and questioning the information's privacy. The purpose of developing the public permissioned network was the implementation of consensus mechanisms that are less expensive in public networks. The main difference between both networks is duties that the nodes can be perform in any network. In the network that is permissioned at most verified nodes can participate. Consensus mechanism in networks that are public, for example Ethereum and Bitcoin, is Proof-of-Work (PoW) [10].
Private permissionless and permissioned networks:

They are different from public networks as the participants are restricted in them. It can be supervised and managed by the single organization or the set of multiple organizations. These organizations have their set of rules which ascertain the allowance of nodes to participate in the network. Every node that participates in the network has equal importance and functions. Once the node is authorized and participates in the network, they can generate transactions. [10]
Permissioned blockchains are more efficient than the permissionless blockchains as it can only be accessed by verified and permissioned users. Hardware affects the performance as well, if we have more specs of hardware configuration, a greater number of transactions can be supported. [4] We will use the results of previous related works to evaluate the effect on performance due to an increase in the number of transactions.
Private permissioned have higher performance than any other platform. We can explain it with this equation.
P = Performance
PriP = Private permissioned
PubP = Public permissioned
PriPl = Private permissionless
PubPl = Public permissionless
P = {PriP > PubP > PriPl > PubPl}

5 Experimental Setup

One of the studies shows that under a specific test environment up to 200tps could be supported by the private blockchain network (Hyperledger). The test environment hardware configuration is 16 vCPUs AWS EC2 instance, 32GB RAM and 3.0 GHz Intel Xeon Platinum processors. 100,000 transactions/participants can be easily supported by the blockchain at 200tps. For 100,000 transactions “query” request response time was 0.01 and “open” request response time was 0.26 that are much less than the expected time. These outcomes can be distinctive under other condition.[4] When we extend the rate of transactions The CPU and the memory usages also derail rapidly to much higher levels. [5] [6]
We observe that some parameters have significant effect on the performance even if we increase the no of transaction, so the parameters are hardware configuration [4], separating metadata, parallelism, separation of resources, caching system [3], stack implementation approach and RAM [1].
Separating metadata: In Fabric the consensus layer receives the input of whole transactions but the only required field is transaction ID which decides the order of transaction. By passing only transaction Ids can increase the throughput.[3]
Parallelism and caching: Validation of some characteristics of transactions can be done by parallelization and some can benefit from transaction data caching. We can design a system in which we parallelize as many as steps of validation and caching the un marshaled blocks at the committer’s end. [3]
Resource separation: When peer roles of committers and endorser are on the same hardware it will affect the performance in a negative way. [3]
Performance can be highly affected by the hardware configuration, If the specifications are higher than the performance will increase in both private and public platforms.

We can show the relationship between no of transactions and performance regardless of any platform and optimization by saying that number of transactions are inversely proportional to performance. Here we can say that all mentioned factors collectively affect the performance.
We can say that the increasing RAM, parallelism and introducing caching systems [3] [5] has the same level priority and right hardware configurations and separation of resources has the same priority [4] stack implementation has same level priority [9].

Higher level --- 3 2 1 ---- lower level

Perram = RAM (level 3)
Percs = Caching System (level 3)
Perpar = Parallelism (level 3)
Perhc = Hardware Configuration (level 2)
Persr = Separation of resources (level 2)
Persi = Stack Implementation (level 1)

$$\text{Higher Performance} = 3(Per_{ram} + Per_{cs} + Per_{par}) + 2(Per_{hc} + Per_{sr}) + Per_{si}$$

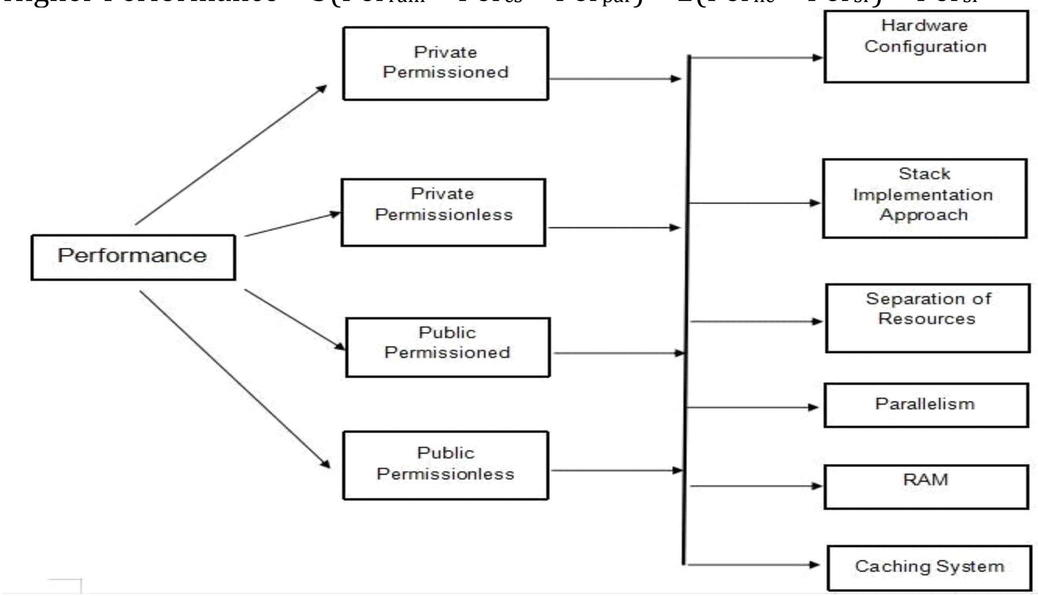

FIGURE 1. relation of performance with blockchain networks with the factors which affect the performance in blockchain

6 Conclusions

The number of transactions does not only affect the performance but there are some other factors like platforms/networks which also affect the performance under the same environment. Here we can say that hardware implementation, caching systems, resources allocation and stack implementation are the parameters or attributes that collectively affect the performance of blockchain. The paper has analyzed and gives comparison between the performance of public permissioned, permissionless network, and private permissioned, permissionless networks of blockchain by varying workload/transactions in different test environments.

7 References

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