ANALYZING THE EFFICIENCY OF BLOCKCHAIN PLATFORMS: A PERFORMANCE EVALUATION PERSPECTIVE

#1KOMARAGIRI KIRAN HRITHIK KUMAR,
#2LALIT ADITYA RAMESH,
#3B.RAMESH, *Assistant Professor,*
Department of Computer Science and Engineering,
SREE CHAITANYA INSTITUTE OF TECHNOLOGICAL SCIENCES, KARIMNAGAR, TS.

ABSTRACT: Blockchain, or BC, is a cryptographic system that allows for the immutable storing of transaction records across various places. This is one of the key reasons why so many businesses are thinking about incorporating blockchain technology into their IT architecture. Even though BC-based systems are used in a range of business solutions, concerns about privacy, scalability, performance, and accessibility persist. Permissioned Blockchain (PBC) frameworks offer a safe way to store sensitive information. The primary goal of this research is to look into the scalability and possible growth of big private blockchain platforms. Every platform was assessed using a variety of roles and success indicators. Businesses may evaluate which private blockchain solution is best for them by conducting extensive research on the benefits and drawbacks of each platform.

Keywords: Block chain, Decentralized, Immutable, Permissioned Blockchain

1. INTRODCUTION

Without the use of intermediaries, BC forms and clarifies agreements. Beyond its original association with Bitcoin, blockchain technology has evolved significantly and is now widely recognized as a great technological achievement. It is feasible to combine distributed ledger technology (DLT), which allows for the creation of numerous copies of records, with blockchain (BC) technology. Numerous frameworks can be used as an adaptive application foundation in the domain of BC. While several initiatives are being tried in British Columbia, there have been some concerns voiced about technological challenges such as latency, capacity, and expansion. There are two types of BC networks: public and private. Individuals can connect to open networks, conduct conversations, and actively search for issues. Because of the network's huge number of nodes, events are separated into discrete parts using the proof-of-work consensus mechanism. Permissionless blockchain systems are resource-intensive and enable unfettered access, which causes issues with performance, scalability, and privacy. PBC networks, on the other hand, are ideal for commercial applications because they only allow authenticated users to access them and do not use consensus processes. As a result, these devices are extremely resource and energy efficient. The following questions are addressed in this study in order to assess the scalability and performance of the PBS platform. Does each Permissioned Blockchain Consortium (PBC) platform demonstrate adaptability to various requirements, such as variations in the number of nodes and transaction volumes, during the review procedure? Why does one platform perform better than the other under certain conditions?

Section II covers topics that are both relevant and interconnected. The following is how this essay is organized: Section III analyzes PBC strategies in depth; Section IV addresses PBC platforms in cloud computing; Section V investigates performance and scalability; and Section VI ends the work.

2.RELATEDWORKS

Dinh et al. propose a set of benchmarks and benchmarking tools for assessing the scalability and effectiveness of these systems. Zheng and colleagues provide a model-checking technique for the PBFT consensus algorithm in healthcare blockchain networks in this paper. To ensure consensus and detect errors, the proposed methodology formalizes the Practical Byzantine Fault Tolerance (PBFT) technique and leverages model-checking techniques. Nakaike et al.'s research makes use of goleveldb to analyze Hyperledger Fabric, a well-known commercial blockchain technology. By examining Fabric's performance in various responsibilities and configurations, this study identifies inefficiencies. In their research, Nasir and his colleagues look at how well Hyperledger Fabric processes massive volumes of data. Pongnumkul et al. used a unique tool to evaluate consensus tactics and configurations in this study. Sukhwani and colleagues give a thorough examination of the performance characteristics of Hyperledger Fabric, an experimental platform built using the proof-of-concept process. To illustrate the behavior of the fabric under various loads and situations, a stochastic process algebra is used. Z. Ma et al. investigated the efficacy of BC consensus systems in the presence of distractions and sleep. The research describes a novel method for evaluating performance that takes into account system sleep stage and network delay. Hald and colleagues look into the positive and negative effects of blockchain technology on supply chain procedures. This article discusses the benefits and drawbacks of blockchain technology in the context of supply chain management, as well as examples of its use. The throughput, latency, and scalability of Hyperledger Fabric, a permissioned blockchain system, are compared in this study. Fabric's efficacy under various burden scenarios and configurations is tested using a proprietary approach.

TableI: comparing and contrasting comparable works.

Author & Citation	Method	Advantages	Disadvantages	Future Scope
Dinh et al. [5]	Benchmarking tools and metrics	Provides a comprehensive assessment of performance and scalability in blockchain systems	Specific limitations or drawbacks not mentioned	Further refinement and enhancement of benchmarking tools and metrics for evaluating blockchain performance and scalability
Yasaweerasinghelage et al. [6]	Architectural modeling and simulation	Predicts latency of BC-based systems using modeling and simulation	Limited to latency prediction, may not cover other performance aspects	Exploration of other performance metrics and analysis techniques for BC-based systems
Zhang et al. [7]	Model-checking approach for verifying PBFT consensus	Ensures correctness of PBFT consensus mechanism using formal model-checking techniques	Focused on PBFT consensus mechanism, may not cover other consensus protocols	Application of model-checking techniques to verify other consensus mechanisms used in blockchain systems
Nakaike et al. [8]	Performance analysis of Hyperledger Fabric using benchmark	Characterizes the performance of Hyperledger Fabric under different workloads and configurations	Specific limitations or drawbacks not mentioned	Further investigation and optimization of Hyperledger Fabric performance based on identified bottlenecks
Nasir et al. [9]	Performance analysis of Hyperledger Fabric	Analyzes scalability and throughput of Hyperledger Fabric in different network topologies and consensus mechanisms	May not cover other performance aspects such as latency	Evaluation and comparison of Hyperledger Fabric performance under different workloads and configurations
Sukhwani et al. [11]	Performance modeling approach for Hyperledger Fabric	Models the behavior of Hyperledger Fabric under different workloads and configurations using stochastic process algebra	Specific limitations or drawbacks not mentioned	Refinement and expansion of the performance modeling approach for other blockchain platforms and consensus mechanisms
Z. Ma et al. [12]	Performance analysis of BC consensus systems	Considers the effect of interference factors and sleep stages on the performance of blockchain consensus systems	Focused on specific factors such as network delay and sleep stages, may not cover other aspects	Further investigation of interference factors and sleep stages on the performance of blockchain systems
Kuzlu et al. [14]	Performance analysis of Hyperledger Fabric	Evaluates throughput, latency, and scalability of Hyperledger Fabric under different workloads and configurations using a custom-built benchmarking tool	May not cover other performance aspects such as security or privacy	Investigation of other performance metrics and comparison of Hyperledger Fabric with other permissioned blockchain platforms in terms of performance, scalability, and other dimensions

3. CONSENSUS PROTOCOLS USED IN VARIOUSPBC PLATFORMS

Consensus mechanisms, particularly blockchains, are critical to the operation of distributed networks. These solutions, which do not require a central authority, make it easier for a group of individuals to agree on system-related issues and accept transactions. Using the consensus method ensures that everyone understands the system consistently and accurately. Public Blockchain (PBC) networks use a variety of consensus processes. The following are some examples.

PBFT

The Practical Byzantine Fault Tolerance (PBFT) protocol assures that a distributed system can reach agreement even when there are Byzantine failures. These are mistakes that occur when specific system nodes act maliciously or arbitrarily. PBC networks only use this approach when nodes are deemed trustworthy.

RAFT

RAFT, like Practical Byzantine Fault Tolerance (PBFT), manages redundant logs in a distributed system efficiently. In the case of network segmentation or node failure, the system guarantees that duplicated records will remain durable. Because of its intrinsic simplicity, Raft is usually preferred over PBFT by developers of fault-tolerant systems.

Kafka

Franz Kafka, the renowned Czech-German author, made significant literary achievements.

One way to think of Kafka is as an event-driven application. In Kafka, a publish-subscribe communication method allows numerous users to post and read data linked to a specific subject. High data processing capacity, defect tolerance, and horizontal scalability are all possible with this technology.

PoA

Certain blockchain networks stress the creation of identification and control over decentralization by using proof of authority (PoA). The Proof of Authority (PoA) consensus process adds new blocks to the blockchain and validates transactions by a small group of validators or authorities. Validators are well-known, respected organizations or persons who have been granted permission to participate in the agreement-making process. Individuals, groups, or corporations are examples of these entities. Proof of Authority (PoA) requires fewer resources than the other two consensus methods, Proof of Work (PoW) and Proof of Stake (PoS). It is preferable to prioritize scalability and efficiency over decentralization.

4. DEPLOYMENT OF BC PLATFORMS

The topic of cloud computing in the context of PBC will be examined in this section. Cloud computing and blockchain (BC) have the potential to improve system startup times, increase accessibility, and enable scalability. Azure was chosen as our platform of choice because it offers Infrastructure as a Service (IaaS) and Platform as a Service (PaaS) options that are suited for building a powerful enterprise network.

Deployment of PoAEthereumon Azure BC Service:

- Using Azure's managed blockchain solution, you can create an Ethereum Proof of Authority (PoA) network and start building a new blockchain network. A Proof of Authority (PoA) Ethereum network can be comprised of a single validator node using this tool. The technique typically consists of the following steps:
- To set up an Azure Blockchain Service, follow the steps below. First, create a new Azure resource group. Next, select the BC Service resource. Finally, configure the BC network's distribution parameters.
- Assemble the network's infrastructure. For consensus decision making, Proof of Authority (PoA) and network parameters such as block duration, gas limit, and network ID are necessary.
- Adding validator nodes is one way to improve system integrity. To reinforce and decentralize the first network, increase the number of validator nodes. To accomplish the previously stated goal, new node keys and certificates must be issued, newly formed nodes must be incorporated into the network, and any network parameters that may be required must be updated.
- The user's text already has an academic tone to it. Once the network has been constructed and active, Remix or Truffle can be used to install and review smart contracts.

Quorum Deployment:

Quorum is a blockchain platform based on the Ethereum protocol that is primarily intended for permissioned network operations in commercial settings. For transactions and contractual agreements, the system provides strong security safeguards, minimum delays, and rapid data processing. Quorum may be run on both private servers and cloud platforms like AWS and Azure.

Corda Deployment:

Businesses can benefit from Corda's solutions for improved privacy and interoperability. Corda enables the creation of decentralized apps that make use of current databases and enterprise technologies. These networks are used by the system, together with cloud services like as AWS and Azure, private and consortium networks, and on-site physical infrastructure.

Deployment of Hyperledger Fabric:

A business-centric platform must be set up and tailored before Hyperledger Fabric can be configured. In modular blockchain networks, smart contracts and consensus methods are used. Hyperledger Fabric works with popular cloud service providers such as AWS and Azure, as well as on-premise hardware setups. The system offers multiple network design and connectivity options.

5. RESULTS & DISCUSSION

Performance metrics are discussed in this section.

PerformanceMetrics

The term latency refers to the amount of time that elapses between the start and end of a procedure. Throughput is a quantitative measurement of how much data or events a system or network can process in a given amount of time.

ConfigurationofEvaluationEnvironment

Azure virtual machines (VMs) were used in the implementation and operation of the previously stated PBC systems. The Standard D4sv3 workstations in our inventory include four 2.8 GHz virtual central processing units (vCPUs). These workstations feature an eight GB memory capacity. Ubuntu 18.04 LTS is installed on all systems.

Performance&ScalabilityAnalysis

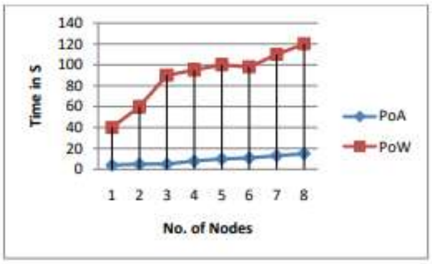

Fig: Latency is a phenomenon in parallel computation.

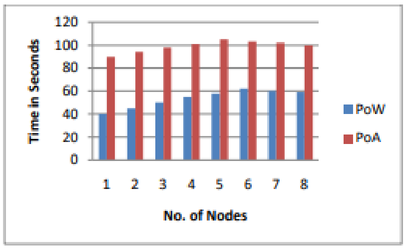

Fig 4: The output of numerous processes and systems is evaluated and compared in this analysis.

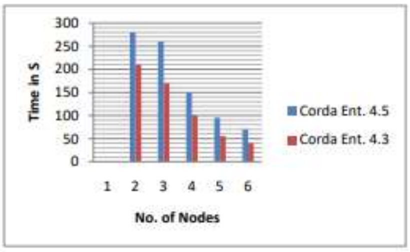

Fig 5: Performance evaluation refers to the process of determining how well someone did in a professional or academic setting.

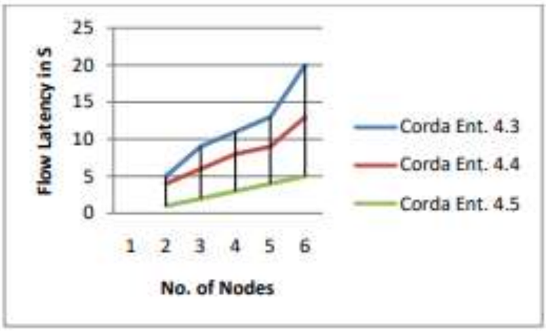

Fig 6: The goal of this study is to compare the latency of various systems.

Figures 3 and 4 show the differences between Ethereum implementations based on the Proof of Work (PoW) and Proof of Authority (PoA) consensus procedures. Because of its improved consensus mechanism, PoA-Ethereum surpasses PoW-Ethereum. Proof of Authority (PoA) is thought to be a more effective and user-friendly consensus mechanism than Proof of Work (PoW). Based on the data in Figure 5, it is clear that Corda Enterprise 4.5 offers more data management capabilities than version 4.3. Figure 6 depicts the relationship between Corda Enterprise's latency and node count. The delay in Corda Enterprise 4.3 grows exponentially with the number of process nodes. To settle bulk transactions, a large number of transactions must be managed concurrently across multiple states. Corda Enterprise 4.4, on the other hand, offers reduced latency than Corda Enterprise 4.3 since it organizes flows over many nodes sequentially. As a result, the cost of each node falls. Corda Enterprise 4.5 uses parallelized flow execution to reduce latency. This strategy improves network scalability. Corda Enterprise 4.5's latency is unaffected by the number of users.

6. CONCLUSION

The purpose of this study was to give a comparative examination of the expansion and performance of PBC systems. Azure was employed in the test to increase the network's size and transaction volume. According to the study's findings, Hyperledger Fabric has higher throughput and reduced latency when compared to other permissioned systems. The outcomes of the study demonstrate that Hyperledger Fabric has advantages for use in applications that require speedy and efficient blockchain transactions that are not publicly available. Learning more and adopting extra measures can help to improve the PBC platform's performance evaluation. It is possible that the concerns may be overcome and the platform consensus procedures will be enhanced in the future.

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