ANALYZING THE PERFORMANCE OF THE PLATFORM IN RELATION TO BLOCKCHAIN TECHNOLOGY

[#1]V NAVATHA, Associate Professor,
Department of Computer Science and Engineering
[#2]YALLA VENKATESWARLU, Professor,
Department of Computer Science and Engineering,
MOTHER THERESA COLLEGE OF ENGINEERING AND TECHNOLOGY, PEDDAPALLY, TS.

ABSTRACT: Blockchain (BC) is a cryptographic method that allows for the secure preservation of immutable transaction records across different locations. As a result, a large number of firms are considering incorporating blockchain technology into their IT architecture. Even if commercial applications adopt BC-based systems, problems about privacy, performance, accessibility, and scalability persist. Permissioned Blockchain (PBC) frameworks offer a safe and dependable way to store sensitive data. The purpose of this research is to assess the scalability and growth potential of big private blockchain networks. Each platform was evaluated using a variety of roles and success criteria. Businesses may accurately evaluate and select the best private blockchain option by methodically weighing the pros and downsides of each accessible platform.

Keywords: Blockchain, Decentralized, Immutable, Permissioned Blockchain

1. INTRODCUTION

Without the use of intermediaries, BC makes transactions transparent and secure. BC is overtaking Bitcoin as the market's leading force. BC makes use of blockchain technology to enable a distributed ledger system that keeps a copy of the ledger. Numerous BC frameworks offer versatile platforms that can be used for a wide range of applications. While several blockchain-based efforts are being considered, there are still worries about potential technological limitations to scalability, throughput, and latency for a BC platform. In British Columbia, there are two kinds of networks: public and private. Anyone with the ability to connect to a publicly available network can initiate and authenticate transactions. With the help of a huge network of nodes, transactions are collected and split into blocks using the proof-of-work consensus approach. Because of their unlimited accessibility and the resource-intensive nature of its consensus method, permissionless blockchain networks confront significant hurdles in terms of speed, scalability, and privacy. PBC networks, on the other hand, are well suited for enterprise applications because they can give verified user access without the complication of consensus processes. As a result, these systems display energy- and resource-efficiency properties. This essay addresses questions about the efficacy and scalability of PBS platforms. Under what conditions does one platform outperform the others? The manner in which each PBC (Permissioned Blockchain Consortium) platform maintains varied needs, such as transaction volume and associated nodes, is of particular importance throughout the approval process.

Comparable attempts are discussed in greater detail in Section II of the text. The fourth portion of the research looks at the connection between PBC platforms and cloud computing services. The protocols used in PBC are described in the third section of the paper. Section V of the study gives and discusses the scalability and effectiveness assessment. The paper's conclusion is stated in Section VI.

2. RELATEDWORKS

Dinh et al. present a comprehensive set of benchmarking instruments and indicators for assessing the effectiveness and scalability of these systems. Zheng et al. describe a model-checking

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mechanism for assessing the PBFT consensus procedure in a blockchain-based healthcare network. This paper explains the Practical Byzantine Fault Tolerance (PBFT) method in detail, utilizing model-checking approaches to discover weaknesses and verify the dependability of the consensus process. Nakaike et al. investigated the usefulness of Hyperledger Fabric, a blockchain technology that is commonly employed in corporate settings. The goleveldb benchmark was used for the evaluation. The book explains Fabric's compatibility with various workloads and configurations, as well as any system constraints. Nasir et al. emphasize the relevance of scalability and throughput in their analysis of Hyperledger Fabric's usefulness. Using a customized benchmarking tool, Pongnumkul and his colleagues compare various consensus approaches and parameters.

Sukhwani et al. present a performance modeling technique created exclusively for the PBC (Permissioned Blockchain Consortium) Hyperledger Fabric platform. Fabric's behavior under various workloads and configurations is characterized using stochastic process algebra. Z assessed the effectiveness of the BC consensus systems. Using conflicting factors and sleep phases, Ma et al. The suggested model provides a novel technique to measuring performance by taking into account a number of interfering elements such as network latency and the system's nap phase.

Hald et al.'s study investigates how British Columbia effects supply chain operations, both favorably and negatively. The book contains a summary of potential benefits and cons related with the use of blockchain technology in supply chain management. Furthermore, it provides empirical support by studying case studies that demonstrate the observable results of blockchain technology implementation. The goal of Kuzlu et al.'s research was to analyze the Hyperledger Fabric platform's throughput, latency, and scalability performance metrics. Fabric's efficacy is validated across a number of workloads and configurations using a bespoke benchmarking tool.

TableI: The study of similar literary works in order to conduct a comparative analysis is known as comparative literature.

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
Zheng 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. CONSENSUSPROTOCOLSUSE DINVARIOUSPBC PLATFORMS

Consensus mechanisms are required for distributed systems such as blockchain networks to function. By allowing a group of users to authenticate transactions and establish consensus on the current system state, these techniques aim to eliminate the need for centralized authority.

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The use of the consensus technique ensures that each member has a thorough awareness of the present state of the system. The consensus protocols that PBC systems typically use are listed below.

PBFT

The Practical Byzantine Fault Tolerance (PBFT) protocol's primary goal is to ensure that a distributed system runs correctly and reaches consensus even when Byzantine faults are present. These flaws explain instances in which certain system nodes act arbitrarily or maliciously. PBC networks usually use well-established and reliable node classifications.

RAFT

RAFT, like the Practical Byzantine Fault Tolerance (PBFT) protocol, is intended to maintain a replicated log in a distributed system. This mechanism's primary goal is to ensure that the duplicated log is always accessible and trustworthy, regardless of network or node failure. The Raft consensus method is widely regarded as a feasible alternative to the Practical Byzantine Fault Tolerance (PBFT) strategy in fault-tolerant system development. Raft's intrinsic simplicity and straightforward installation procedure influenced this decision.

Kafka

In reaction to specific events or incidents, the software application Kafka is launched. Kafka offers the publish-subscribe communication mechanism, which allows several producers to publish data to a certain topic and multiple consumers to receive that data. Furthermore, it enables high throughput, fault tolerance, and horizontal scaling.

PoA

In some BC networks, where identification and authority take precedence over decentralization, Proof of Authority (PoA) is used. Proof of Authority (PoA) is a consensus technique that validates transactions and adds new blocks to the blockchain by a small set of authorized nodes. These entities are frequently referred to as authorities or validators. Institutions, organizations, and individuals with the relevant power are invited to participate in the consensus process. Proof of Authority (PoA) procedures are designed to be more efficient and effective than Proof of Work (PoW) and Proof of Stake (PoS) procedures. However, in order to maximize efficacy and scalability, certain decentralization qualities must be surrendered.

4. DEPLOYMENT OF BC PLATFORMS

In this part, we look at how Predicate-based Encryption (PBC) is used in cloud computing services. The combination of business continuity (BC) and cloud computing provides various advantages over traditional on-premises networks, including faster system initialization, improved accessibility, and increased scalability. The Azure platform, which offers Platform-as-a-Service (PaaS) and Infrastructure-as-a-Service (IaaS) service models, was chosen as the best option for developing a proof of concept with a fully functional business continuity network architecture.

Deployment of PoA Ethereum on Azure BC Service:

A Proof of Authority (PoA) consensus-based Ethereum network can be constructed on the BC service using Azure's managed BC service. This service provides a proof-of-work Ethereum network with a single validator node that has been preconfigured. The technique typically consists of the following steps:

Microsoft supplies the Azure cloud computing platform and service. Create a new instance of the BC Service class object. To do so, create a new Azure resource group, choose the BC Service resource, and set the deployment criteria for the BC network.

Creating network settings entails designing the network architecture, deciding on Proof of Authority (PoA) as the consensus technique, and determining network parameters like as block time, gas limit, and network ID.

It is proposed that the number of validator nodes be increased. Following the establishment of the network, additional validator nodes can be added to promote scalability and decentralization. This necessitates adding additional nodes to the network, creating new nodes, and establishing new node keys and certificates. Once the network is in place, smart contract implementation and testing can be streamlined with tools like Remix or Truffle.

Quorum Deployment:

Quorum is a network deployment platform for enterprises that uses permissioned access and runs on the Ethereum blockchain. Private transactions and confidential contracts, as well as quick data transfer velocities and low latency, are among the privacy-enhancing features of the technology. Quorum can be installed on-premises or in the cloud using services such as AWS and Azure.

Corda Deployment:

Corda is intended for usage in commercial situations, as it has privacy and interoperability characteristics. Corda makes it easier to create decentralized applications that can interact with current business systems and databases. The solution supports the installation of private and consortium networks, in addition to on-premises infrastructure and cloud services like as AWS and Azure.

Deployment of Hyper ledger Fabric:

Enterprise and commercial applications are the core design and development goals of Hyperledger Fabric. Using technology like consensus procedures and smart contracts makes it easier to build modular blockchain networks. Hyperledger Fabric enables network adaptability and system integration, making it compatible with on-premise infrastructure as well as cloud services like AWS and Azure.

5. RESULTS

This section is mostly concerned with performance measures.

Performance Metrics

Latency is commonly described as the time elapsed between the start of a procedure and its completion. The amount of data or transactions that a system or network can process in a given length of time is referred to as throughput.

Configuration of Evaluation Environment

On Azure virtual computers, the previously stated PBC platforms were installed and made operational. Four 2.80 GHz virtual central processing units (vPUs) and eight gigabytes of RAM were used in standard D4sv3 instances. Ubuntu 18.04 LTS was the operating system installed on each node.

Performance & Scalability Analysis

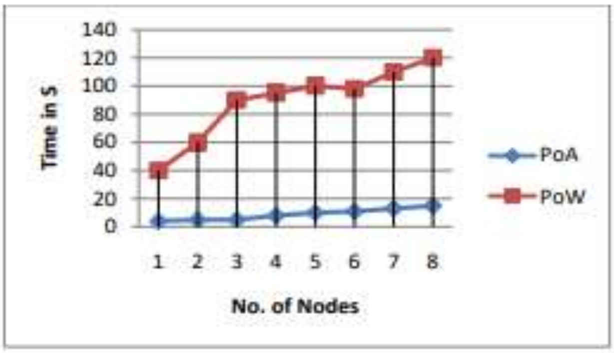

Fig3: The examination of delays is of particular relevance.

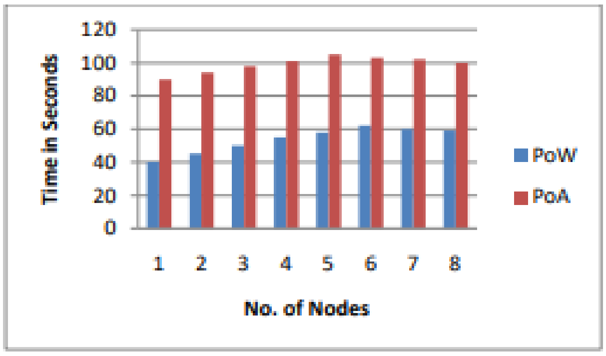

Fig 4: There are similarities and variations between the ideas of computability that bear research when contrasted to other concepts.

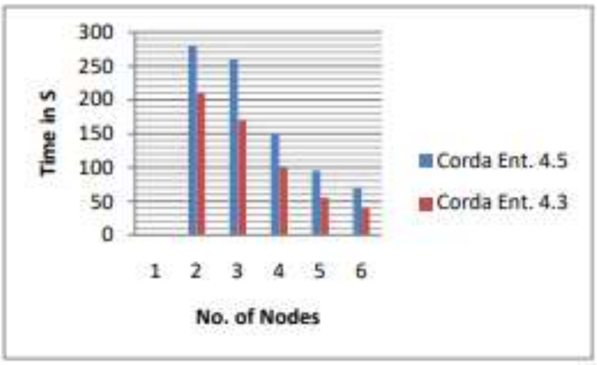

Fig 5: The evaluation of a person's academic or professional performance.

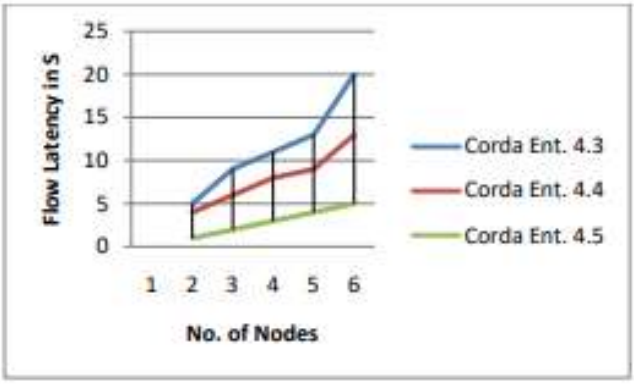

Fig The evaluation of a person's academic or professional performance.

Figures 3 and 4 show how Proof of Authority (PoA) and Proof of Work Ethereum (PoWEthereum) systems operate differently. Because a more efficient consensus mechanism was used, the PoA-Ethereum deployment is more efficient than the PoW-Ethereum deployment. Proof of Authority (PoA) is a more efficient and straightforward procedure than Proof of Work (PoW). Figure 5 illustrates the data suggesting that Corda Enterprise 4.5 has a significantly higher throughput than Corda Enterprise 4.3. The link between the number of Corda Enterprise nodes and the observed delay is depicted in Figure 6. Latency in Corda Enterprise 4.3 has been proven to grow exponentially with the number of nodes involved in a transaction. The adoption of the bulk transaction resolution technique, which allows for the continuous processing of several states, causes this behavior. Corda Enterprise 4.4, on the other hand, has a significant reduction in latency when compared to version 4.3. This improvement is due to the sequential processing of flows between nodes, which lowers node expenses. Corda Enterprise 4.5 is more scalable in terms of network size and has much lower latency due to its usage of the parallelized flow technology. The addition of new players has no significant influence on the latency of Corda Enterprise 4.5.

6. CONCLUSION

The purpose of this research was to look into the efficacy and growth potential of various PBC systems. The evaluation involved expanding network bandwidth and altering the amount of concurrent transactions using the Azure cloud computing platform. In terms of throughput and latency, Hyperledger Fabric outperforms other permissioned platforms empirically, indicating stronger throughput capabilities. According to the findings of the study, Hyperledger Fabric shows a lot of potential as a viable choice for deploying applications in permissioned blockchain environments where transaction speed and operational efficiency are critical. However, the effectiveness of the PBC platform must be improved. Additional research could potentially solve previously highlighted flaws and improve the consensus mechanisms employed by these platforms.

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