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ASSESSING THE EFFICACY OF BLOCKCHAIN PLATFORMS

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ABSTRACT: Blockchain (BC) is a type of encryption that allows for the storage of unchangeable transaction records in various locations. As a result, many firms are eager to incorporate BC into their IT systems. Even while BC-based systems are employed in commercial solutions, there are still valid concerns concerning privacy, performance, accessibility, and growth. Frameworks for Permissioned Blockchain (PBC) offer a secure means to store sensitive information. The primary purpose of this research is to examine how well and easily huge private BC platforms can grow. Each platform was evaluated using a variety of tasks and success metrics. Businesses may make informed decisions about which private BC option to choose by comparing the positives and cons of each platform.

Keywords:: Blockchain, Decentralized,Immutable,Permissioned Blockchain

1. INTRODCUTION

Without the use of intermediaries, BC offers secure and transparent transactions. BC has overtaken Bitcoin as the market leader. BC supports a distributed ledger technology (DLT) that replicates an exact copy of the ledger. There are already a number of BC frameworks available that provide adaptable platforms for a wide range of applications. Despite the fact that various BC initiatives are now being assessed, there are worries regarding the technological challenges that a BC platform would encounter in terms of scalability, throughput, and latency. There are two types of BC networks: public and private. Anyone with access to a public network can initiate and verify transactions. Because of the wide network of nodes, transactions are grouped and separated into blocks using a proof-of-work consensus technique. Permissionless blockchain networks face substantial speed, scalability, and privacy challenges due to their open-access nature and resource-intensive consensus mechanism. PBC networks, on the other hand, are perfect for enterprise applications since they offer verified user accessibility without the complexity of consensus approaches. As a result, these platforms are both resource and energy efficient. This article tackles the following concerns about the performance and scalability of PBS platforms: Under what conditions does one platform outperform the others? How does each PBC platform handle varying demands, such as the amount of transactions and related nodes, during evaluation?

Section II contains information about similar works. The protocols used in PBC are explained in Section III. Section IV discusses the application of PBC platforms in cloud computing services. Section V presents and discusses the efficacy and scalability evaluation. The paper's conclusion is stated in Section VI.

2. RELATED WORKS

Dinh et al. provide a set of benchmarking tools and indicators for assessing the effectiveness and scalability of these systems. Zheng et al. present a model-checking mechanism for testing the PBFT consensus process in a healthcare BC network. It presents a formal description of the PBFT algorithm and uses model-checking techniques to discover weaknesses and assure the accuracy of the consensus process. Nakaike et al. examine the performance of Hyperledger Fabric, a popular corporate BC platform, using the goleveldb benchmark. It describes Fabric's efficacy under different workloads and configurations and reveals system bottlenecks. Nasir et al. emphasize the system's scalability and throughput in their Hyperledger Fabric performance analysis. Pongnumkul et al. compare the performance of various consensus mechanisms and setups using a custom-built benchmarking instrument. Sukhwani et al. provide a performance modeling technique for the PBC platform Hyperledger Fabric. Fabric's behavior under varied workloads and configurations is described using stochastic process algebra. Z. Ma et al. evaluated the performance of BC consensus systems when interference factors and sleep stages were present. It proposes a new performance model that considers interference elements like network delay and the system's sleep stage. Hald et al. study how British Columbia influences the facilitation and restriction of supply chain operations. It includes a list of the potential advantages and disadvantages of using BC in supply chain management, as well as case studies demonstrating the real-world effects of BC adoption. Kuzlu et al. examined the performance of the PBC platform Hyperledger Fabric in terms of throughput, latency, and scalability. A custom-built benchmarking tool is used to assess Fabric's performance across a range of workloads and configurations.

Table I: investigation of comparable works for comparison

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. CONSENSUS PROTOCOLS USED IN VARIOUS PBC PLATFORMS

Blockchain networks and other distributed systems require consensus methods to function. They are intended to allow a group of users to authenticate transactions and agree on the condition of the system without requiring centralized authority. The consensus procedure ensures that everyone understands the system's status. Some of the consensus protocols utilized by PBC platforms are listed below..

PBFT

PBFT is designed to ensure that a distributed system can continue to operate accurately and establish agreement in the presence of Byzantine faults, in which some nodes may act arbitrarily or maliciously. It is widely used in PBC networks when a known and trusted group of nodes is predetermined.

RAFT

RAFT, like Practical Byzantine Fault Tolerance (PBFT), is intended to handle a replicated log in a distributed system. It ensures that the replicated log remains reliable and accessible in the event of network or node failure. Raft is a popular fault-tolerant system development alternative to PBFT because it is more obvious and easier to implement.

Kafka

Kafka is a program that is triggered by events. Kafka supports a publish-subscribe communication mechanism, allowing several producers to post data to a topic and multiple consumers to receive data sent to the same subject. It also allows for horizontal scaling, fault tolerance, and high throughput.

PoA

In some BC networks, where identity and authority are more important than decentralization, Proof of Authority (PoA) is used. In PoA, a small number of approved nodes are in charge of validating transactions and adding new blocks to the BC. These are referred to as validators or authority. Institutions, organizations, or individuals with authority to engage in the consensus process are reputable and well-known. PoA is meant to be more efficient and effective than PoW and PoS. Nonetheless, some decentralization is sacrificed for performance and scalability.

4. DEPLOYMENT OF BC PLATFORMS

This section discusses the use of PBC on cloud computing services. Integrating BC with cloud computing provides various benefits over on-premises networks, including simple system booting, access, and scalability. Azure, which offers IaaS and PaaS service models to supply a fully configured BC network topology, was chosen to construct a proof of concept.

Deployment of PoA Ethereum on Azure BC Service:

A Proof of Authority (PoA) Ethereum network can be established on the BC service using Azure's managed BC service, which provides a preconfigured Proof of Authority (PoA) Ethereum network with a single validator node. The following stages are frequently included in the procedure:

Azure: Make a new instance of the BC Service. This necessitates the formation of a new Azure resource group, the selection of the BC Service resource, and the definition of the deployment parameters for the BC network.

Configuring network parameters can include things like designing the network architecture, choosing PoA as the consensus mechanism, and providing network features like block time, gas limit, and network ID.

Add more validator nodes: Following the establishment of the basic network, additional validator nodes can be added to promote decentralization and scalability. This necessitates adding additional nodes to the network, generating new nodes, and creating new node keys and certificates.

Once the network is up and running, smart contracts can be installed and tested using tools like Remix or Truffle.

Quorum Deployment:

Quorum is a permissioned network deployment framework for enterprises built on the Ethereum blockchain. It has a fast throughput and low latency, as well as privacy features including private transactions and confidential contracts. Quorum can be installed on-premises or in the cloud utilizing services such as AWS and Azure.

Corda Deployment:

Corda is intended for commercial use and includes privacy and interoperability features. Corda allows for the development of distributed applications that can interact with existing databases and corporate systems. It supports both on-premises infrastructure and cloud services such as AWS and Azure, as well as private and consortium network deployments.

Deployment of Hyperledger Fabric:

Hyperledger Fabric is intended for business use. It makes it easier to build modular BC networks and includes features like smart contracts and consensus mechanisms. Hyperledger Fabric allows network adaptability and interaction with current systems, and it can be used on both on-premise infrastructure and cloud services like AWS and Azure.

5. RESULTS

This section focuses mostly on performance metrics..

Performance Metrics

Latency is defined 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

The aforementioned PBC platforms were deployed and rendered operational on Azure virtual computers. We used Standard D4sv3 instances with four 2.80 GHz vCPUs and eight gigabytes of RAM. Ubuntu 18.04 LTS was installed as the operating system on each node.

Performance & Scalability Analysis

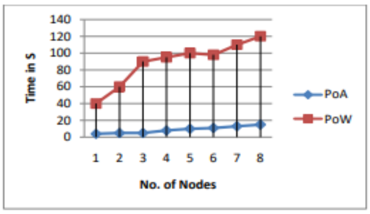

Fig 3: a delay measurement

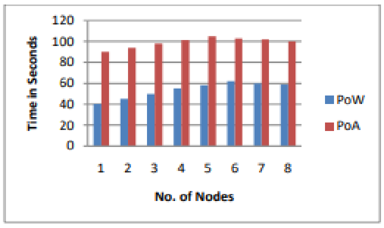

Fig 4: Computability in comparison

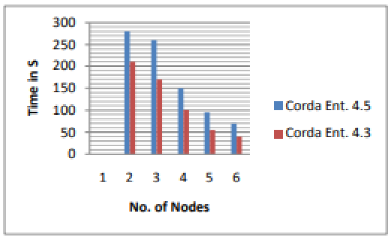

Fig 5: Performance Evaluation

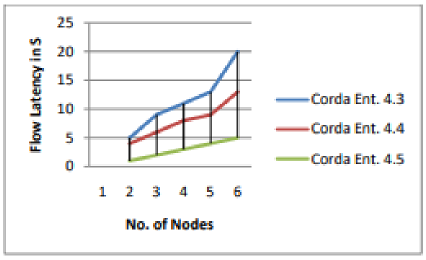

Fig 6 When comparing latencies

Figures 3 and 4 show the performance differences between PoA and PoW Ethereum. Because of the implementation of a more efficient consensus mechanism, the PoA-Ethereum deployment is more efficient than the PoW-Ethereum deployment. The PoA process is both easier and more effective than the PoW procedure. Figure 5 shows that, when compared to Corda Enterprise 4.3, Corda Enterprise 4.5 has a significantly higher throughput. Figure 6 demonstrates how the number of Corda Enterprise nodes affects latency. As shown, the latency of Corda Enterprise 4.3 grows exponentially with the number of nodes involved in a transaction. This is because the bulk transaction resolution approach processes many states at the same time. Corda Enterprise 4.4, on the other hand, has a considerable drop in latency as compared to version 4.3 since it processes flows across nodes sequentially, minimizing node costs. Because of the parallelized flow approach, Corda Enterprise 4.5 has the lowest latency, making it the most scalable version in terms of network size. The existence of additional participants has little effect on Corda Enterprise

4.5 latency.

6. CONCLUSION

Finally, the efficacy and scalability of several PBC platforms were assessed in this study. The evaluation involved altering the number of concurrent transactions and increasing the network size using the Azure cloud computing platform. The data show that Hyperledger Fabric surpasses other permissioned platforms in terms of throughput and latency, with better throughput. According to the research, Hyperledger Fabric is a promising solution for applications in permissioned blockchain environments that prioritize transaction speed and efficiency. Nonetheless, there remains room for improvement in PBC platform performance evaluation. Future research can help to overcome the concerns identified and improve the platforms' consensus processes.

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