

Data Health Functionality using Hyperledger Fabric Technology

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Abstract

A permissioned blockchain infrastructure called Hyperledger Fabric offers a modular architecture, smart contract execution, configurable consensus, membership services, and a representation of roles between the nodes present in the infrastructure. It also provides high rated integrity sharing. Since patient health records are highly confidential, in order to maintain security, this study examines how to communicate medical data with better privacy protection in healthcare. The transfer of health-related data functions using Hyperledger framework improves the storage reliability and security. Furthermore, the healthcare supply chain process can be improved by hyperledger fabric networks by enhancing the visibility and traceability of network interactions. Companies that have accessibility to the ledger on a fabric network can see the same unchangeable data, enforcing responsibility and lowering the possibility of counterfeiting. This study's findings showcase the utilization of blockchain technology to improve the privacy of data sharing and storage in the healthcare sectors.

Keywords: Data fabric, secure data, IoT signal, data mining, data integration, data intelligence

1. Introduction

1.1 Data Fabric

Data fabric is an architecture that provide an end-to-end data integration by using intelligent and automated techniques through cloud environments. During the last decade, advances in Artificial Intelligence (AI), hybrid cloud, internet Internet of Things (IoT), and edge computing have resulted in rapid growth of big data, as well as increased complexity for enterprises. The data fabric enables enterprises to manage their data and handle complex data

problems due to the various types of applications, platforms, and storage locations. A collection of hardware and software infrastructure, tools, and facilities are used to implement, administer, manage, and operate data operations throughout the enterprise operations, including data acquisition, transformation, storage, distribution, replication, availability, security, disaster recovery, analytics, backup, retrieval, archival, monitoring, and capacity management. Mesh provides access to all data assets and transport data around the company. It also supports the flow, processing, distribution, management, and exchange of data throughout the enterprise. It is independent of specific applications and data platforms.

1.2 Hyperledger Fabric

Hyperledger is an open-source platform to offer distributed ledger solution in industrial level. It is a private and permissioned blockchain framework and it is used to develop blockchain based application, networks, etc. Fabric is made to provide pluggable implementation of various components, enable the creation of private blockchains, and account for the intricate details of various economic systems.

A node only a logical function that means the multiple nodes are run on the same physical server. Nodes are joined in trust domain and associated to logical entities that control them. Three types of nodes used in the Hyperledger architecture.

- Client or submitting client
- Peer
- Ordering service node

Client: The client represents the entity that acts as an end-user. It connects to the peer for communicating with the blockchain. Assume the client can connect to any peer of its choice, which means clients can create and thereby invoke transactions.

Peer: A peer maintains the state and ledger by receiving blocks of ordered state updates from the ordering service. Peer is the location, where the ledger and blockchain data is stored. Include more than one peer in the production; that peer may be involved in multiple channels. It generates a backup of the ledger from the peer and approves any changes to the ledger.

Ordering Service Node: Ordering service is more important of consensus algorithm and hyper ledger fabric. The primary function of this service is to provide the order of operations. Before adding anything to the ledger, it must go via ordering service, which is also responsible of verification, security, etc.

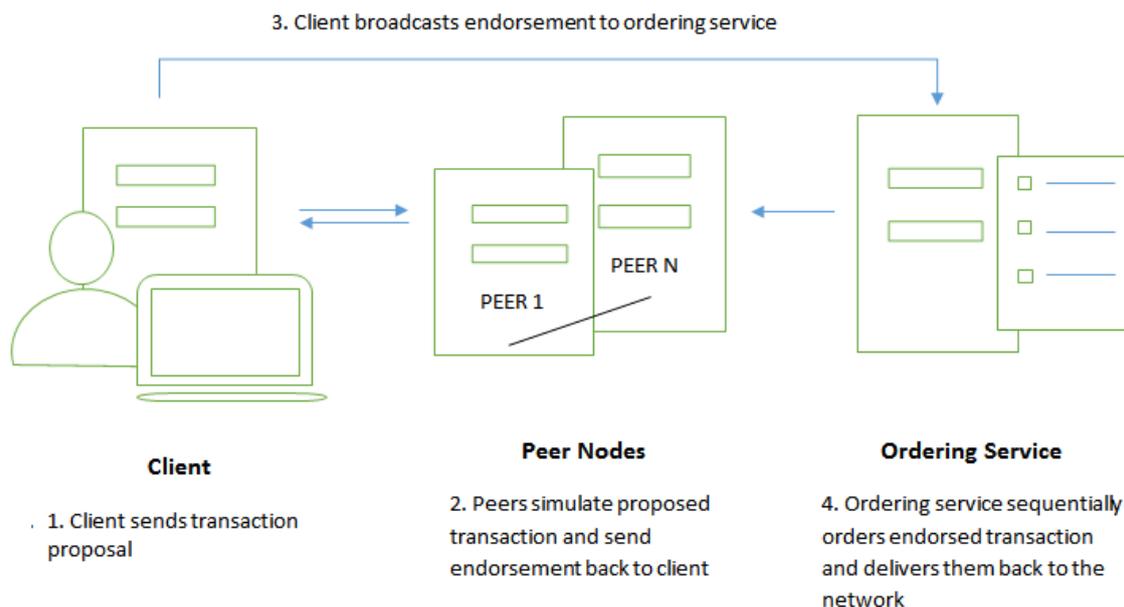


Figure 1. Hyperledger Fabric Transaction Flow

Figure 1 shows the transaction flow in the Hyperledger fabric. There are three stages: client, peer nodes and ordering service. A client initiates the transaction by submitting a transaction request for approval to peers within each organisation. After submitting the transaction, the peers confirm the authenticity and identity of the client. Next, it match the results of the suggested transaction and if it matches, it gives an approval in return to the client. The client seeks peer approval before sending transaction to the provided service after receiving the required number of endorsements as specified in the endorsement policy. Finally, the ordering service ensure that the transaction has the proper number of approvals to meet the endorsement policy. The approved transactions then chronologically orders and gets packed into blocks and further send these nodes within each organization. The ordering service sends new blocks of transactions to peer nodes and then carry out a complete validation for transaction performed in that node. When this is finished, the ledger's state is modified and the new block gets inserted.

2. Existing Frameworks

Recent research works focuses on sharing data with similar or different organisations. They are also focused on the privacy and security of establishing data exchange across businesses. Few researchers focused on the discussion of some enhanced technologies and applications, as shown in Table 1, while others detailed the trends in related research.

Atreyapurapu et al [1] describes a hyperledger fabric technology utilised for enabling enhanced security and privacy when transmitting the data between industrial applications. It securely tracks all records for doctors .

Zhao et al [2] proposed a Interplanetary File System (IPFS) method to archive symmetric key data sharing through secure data sharing mechanism. To increase flexibility and efficiency, a decentralised, fine-grained, and attribute-based access control mechanism is used.

In [3], authors evaluated the performance of Hyperledger tool and they found Hyperledger fabric raft consensus process provides high throughput, user friendliness, user transparency, fault tolerance and scalability. It also examined the effects of different transactions and chain codes on transaction performance and delay.

Chen et al [4] investigated the performance of Hyperledger blockchain scheme to enhance the security and privacy of data transmitted by all parties in industrial system. The Elliptic curve digital signature algorithm has examined the non-repudiation, resistance against known cyberattacks and increase the scalability of the system.

Shih et al [5] discussed about the IoT and access control scheme based on smart contracts. Device contract, policy contract and access contract are the three main contracts included in this discussion. It utilizes the decentralized, traceable, and other features of blockchain to address the access control challenges in IoT environment.

In [6], authors have empirically investigated the method of coffee supply chain integrated with Hyperledger blockchain. DLT in Hyperledger Fabric offers various problems. To overcome this problem, they used coffee supply chain, which is more reliable, robust, modular and trustworthy.

Hang et al [7] proposed a fuzzy logic to improve the blockchain performance. It is used to decrease the transaction latency and increase the transaction throughput. Scaling and performance should also be improved.

Another investigation [8] studied the Hyperledger fabric network performance related to AWS and chaincode. The batch-timeout and block size is used to improve the performance, maintain high throughput, and achieve low latency.

Khan et al [9] analysed the performance of Blockchain-Internet of Medical Things (BIOMT). A distributed architecture used for Blockchain-Internet of Medical Things to

reduce the resource consumption, including that of computation, network, and storage will increase the environment reliability. The overall architecture of the proposed BIoMT has been correctly organised to become more secure, protected, and resource-efficient without compromising the ecosystem while maintaining a strong infrastructure for patient information traceability and integrity without any repudiation.

Gaba et al [10] investigated the effectiveness of blockchain with Vehicular Ad-hoc Networks (VANETs). A blockchain-based VANET's total block size grows as the number of transactions increases, the endorsement policy changes, and more reads and writes occur within a single transaction. This helps to reduce latency and increase throughput and network utilisation.

Table 1. Review on Hyperledger Fabric Technology in Healthcare

Reference	Technique	Application	Outcome	Advantage
Atreyapurapu et al [1]	Hyperledger Fabric	Distributed Ledger Protocol (DLT)	With better security, doctors can keep track of every record	Secure storage of public and personal data
Zhao et al [2]	InterPlanetary File System (IPFS) and Linear integer secret sharing	Decentralized fine-grained and attribute-based access control scheme	Symmetric key sharing through secure data sharing	High Security Feasibility Effectiveness
Shammar et al [3]	Hyperledger Fabric blockchain network and IoT	Hyperledger Caliper benchmark tool and Hyperledger Fabric Raft consensus mechanism	User-friendliness User-transparency Fault-tolerance Scalability Compatibility	Lower the risk of a single point of failure Low overall system efficiency Ethical and privacy issues
Chen et al [4]	Hyperledger Fabric blockchain	Hyperledger Fabric blockchain-based secure data transfer scheme, Elliptic Curve Digital Signature Algorithm (ECDSA), Chaincode and InterPlanetary File System (IPFS)	Transmission of data to all industrial systems with maximum security and privacy	To increase the scalability of the system Good traceability and performances Non-repudiation Resistance against known cyber attacks
Shih et al [5]	Hyperledger Fabric blockchain technology	Attribute-based access control (ABAC), Smart contracts and IoT	Implementation of the Industrial Internet of Things (IIoT) System to reduce the spread of security vulnerabilities	Used to establish frequent transmission of numerous rich data streams
Ravi et al [6]	Hyperledger Fabric	Hyperledger Caliper, Chaincode, Coffee Supply Chain	coffee supply chain to improve the security and privacy	More reliable, robust, modular, and trustworthy
Hang et al [7]	Hyperledger Fabric Network	Fuzzy Logic in Smart Contract	Fuzzy logic to boost blockchain performance.	Less transaction latency Improve the transaction throughput

Honar et al [8]	Hyperledger Fabric and IoT	AWS and Chaincode	To achieve better performance using chain code To maintain the high throughput using batch-timeout and block size of IoT applications and also to achieve low latency	Reduced latency Improved transaction throughput Better performance
Khan et al [9]	Blockchain Hyperledger Fabric	Blockchain- Internet of Medical Things (BIOMT)	Using BIOMT to transmit the data more securely and store specific transaction information on the ledger.	It reduces the cost of medical transaction & service deliverance information verification and validation.
Gaba et al [10]	Hyperledger Fabric Private Blockchain Network (HFPBN)	Vehicular Ad-hoc Networks (VANETs), Hyperledger Caliper	Hyperledger Fabric to increase the privacy and security. Increasing the number of transactions and altering endorsement policies and lead generation through the use of VANET.	It improves the performance, scalability, and privacy.

3. Review Discussion

The modern world is characterized by new technologies and also cyber-attacks. Secure data management is especially challenging in the healthcare industry. Since the cloud stores a significant amount of sensitive data, including medical records and, in particular, the ability for patients to use their own signatures. As a result, the management keeps the data in a more sensitive manner.

Hyperledger fabric blockchain technology is used to securely share, maintain and store the data. If sensitive data is stored on the blockchain, it will help to solve the high- and low-level cyberattacks. This type of blockchain is simply a lookup table that only protects reference data and does not protect actual personal data. To assist the healthcare sector, sensitive data must be stored on the blockchain, which will require applications to assume greater responsibility. To account for the challenges of blockchain, the application must convert all data to text, provide script-level encryption, and include some form of access control. The Hyperledger fabric framework's privacy-preserving mechanism and the smart contract to enable hierarchical access control is used to develop a novel solution. A lot of use cases in the healthcare sector can be satisfied by the advantages of Hyperledger Fabric, which include enterprise-level distributed ledger technology, pluggable functionalities (such as

consensus methods, components, member administration services, etc.), modularity, and ubiquitous architecture.

The use of consortium chains-based hyperledger fabric architecture becomes a more viable solution in the healthcare industries to communicate essential information among hospitals, medical groups, research organisations, and insurance firms. Henceforth, the Hyperledger Fabric architecture is considered as the most secured information sharing technology. Some of the healthcare applications using Hyperledger technology is shown in Table 2.

Table 2. Healthcare Applications using Hyperledger Technology

Applications	Significant
Axual	It is a digital network that makes use of Hyperledger technology to quickly check credentials, credentials, and validity.
KitChain	It proposes to provide a solid collaborative paradigm for controlling the clinical supply chain for pharmaceuticals. Tracking shipments and events without the use of paper or manual translation by creating an unchangeable record. It has two important components Mobile application for frontend Blockchain server for backend
MELLODDY Project	This drug program operates ML algorithms developed by AWS technologies. Only non-sensitive models are shared, and the data never leaves the owners infrastructure. Each partner can share a similar model that can be collectively aggregated in accordance with a central distributor.
MyClinic.com	The ethical standard for the sector is to give patients access to their medical records. Direct patient access to their data removes constraints on patient choice and interoperability that currently exist in healthcare. Using an Android or iOS app, it is simple to schedule visits, go over medical results, and ask for additional research or support.
Verified.Me	Verified. Me is a blockchain-based digital identity network built on Hyperledger Fabric 1.2 that gives users control over their information by letting them decide with whom and when to disclose it, preventing unwanted oversharing of private data.

4. Conclusion

This work summarizes the review of Hyperledger Fabric technology used in the healthcare sectors. The privacy of data transmitted to hospitals, medical groups, and other institutions is an increasing concern in medical industry. This study has provided a broad overview on the privacy of healthcare records. Many applications are developed in the healthcare industries by using Hyperledger blockchain techniques like MediConCen, Aruba

Health App, Axuall, KitChain, MyClinic.com, XATP etc.. Upcoming methodology concentrate on the features of healthcare data in real world, which also enhances the blockchain's scalability and performance.

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Author's biography

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