EXPERIMENT NO.: 06
CASE STUDY ON HYPERLEDGER FABRIC

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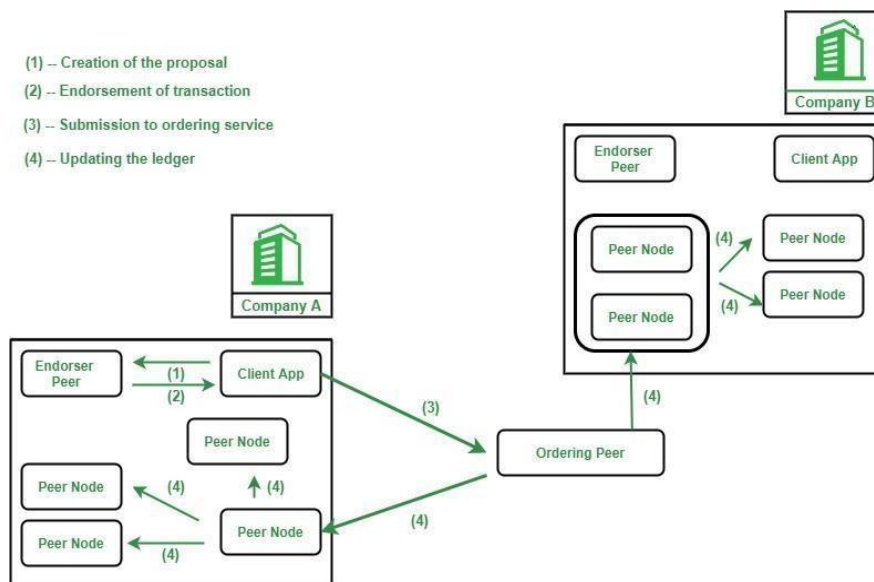**Blockchain Lab**

–What is Hyperledger fabric?

Hyperledger Fabric is an open source blockchain framework developed for building permissioned blockchain networks tailored for enterprise applications. It provides a modular architecture that allows organizations to customize consensus protocols, membership services, and smart contract execution according to their specific requirements. Fabric emphasizes privacy, confidentiality, scalability, and flexibility, making it suitable for a wide range of business use cases. With its focus on permissioned networks, Fabric enables organizations to control access, manage identity, and ensure regulatory compliance while leveraging blockchain technology for enhanced transparency, traceability, and efficiency in their operations. Smart contracts document the business processes you want to automate with self-executing terms between the parties written into lines of code. The code and the agreements contained therein exist across the distributed, decentralized blockchain network. Transactions are trackable and irreversible, creating trust between organizations and enabling businesses to make more informed decisions quicker—saving time and reducing costs and risks.

Overall, Hyperledger Fabric provides a comprehensive and customizable framework for building enterprise-grade blockchain applications with features tailored to the needs of businesses across various industries. Its emphasis on privacy, scalability, and flexibility makes it a popular choice for organizations seeking to leverage blockchain technology to improve transparency, efficiency, and trust in their operations.

Features :

1.   Permissioned network: Fabric allows organizations to set up permissioned networks where participants are known entities, providing privacy and confidentiality.

2.   Modular architecture: Fabric's modular architecture allows components such as consensus algorithms, membership services, and smart contract execution to be plug-and-play, enabling customization for different use cases.

3.   Smart contracts (Chain code): Fabric uses smart contracts called "chaincode" to define transaction logic. Chaincode can be written in various programming languages such as Go, JavaScript, or Java.

4.Privacy and confidentiality: Fabric supports private channels, allowing for confidential transactions between a subset of network participants. This feature is particularly useful in business scenarios where certain data needs to be kept confidential.

5.Scalability: Fabric is designed to scale horizontally, with the ability to add more nodes to the network to handle increased transaction throughput.

6.Endorsement policy: Fabric allows for customizable endorsement policies, determining which subset of network participants must agree on the validity of a transaction.

Workflow :

Components:

Hyperledger fabric is an enterprise-level permission blockchain network. It is made up of various unique organizations or members that interact with each other to serve a specific purpose. For example, these organizations can be a bank, financial institution, or a supply chain network. Each organization is identified and they have a fabric certificate authority. These organizations are called members. Each

member of the fabric can set up one or more authorized peers to participate in the network using the fabric certificate authority. All of these peers must be authorized properly.

There is a client-side application connected to the network written with the software development kit (SDK) of any particular programming language.

Steps :

For each and every transaction in the fabric, the following steps are followed-

1.Creation of the proposal: Imagine a deal between a smartphone manufacturer company and a smartphone dealership. The transaction begins when a member organization proposes or invokes a transaction request with the help of the client application or portal. Then the client application sends the proposal to peers in each organization for endorsement.

2.Endorsement of the transaction: After the proposal reaches the endorser peers (peers in each organization for endorsement of a proposal) the peer checks the fabric certificate authority of the requesting member and other details that are needed to authenticate the transaction. Then it executes the chain code (a piece of code that is written in one of the supported languages such as Go or Java) and returns a response. This response indicates the approval or rejection of the following transaction.

The response is carried out to the client.

3.Submission to ordering service: After receiving the endorsement output, the approved transactions are sent to the ordering service by the client-side application. The peer responsible for the ordering service includes the transaction into a specific block and sends it to the peer nodes of different members of the network.

4.Updating the ledger: After receiving this block the peer nodes of such organizations update their local ledger with this block. Hence the new transactions are now committed.

Benefits Of Hyperledger Fabric

1.   **Open Source:** Hyperledger fabric is an open-source blockchain framework hosted by the Linux foundation. It has an active community of developers The code is designed to be publicly accessible. Anyone in the community can see, modify, and distribute the code as they see fit. People across the world can come and help to develop the source code.

2.   **Private and Confidential:** In a public blockchain network each and every node in the network is receiving a copy of the whole ledger. Thus keeping privacy becomes a much bigger concern as everything is open to everyone. In addition to this one, the identities of all the participating members are not known and authenticated. Anyone can participate as it is a public blockchain. But in the case of Hyperledger fabric, the identities of all participating members are authenticated. And the ledger is only

exposed to the authenticated members. This benefit is the most useful in industry-level cases, like banking, insurance, etc where customer data should be kept private.

3.   **Access Control:** In the Hyperledger fabric, there is a virtual blockchain network on top of the physical blockchain network. It has its own access rules. It employs its own mechanism for transaction ordering and provides an additional layer of access control. It is especially useful when members want to limit the exposure of data and make it private. Such that it can be viewed by the related parties only. As an example when two competitors are on the same network. The fabric also offers private data collection and accessibility, where one competitor can control the access to its own data such that the data do not get exposed to the other competitor.

4.   **Chaincode Functionality**: It includes a container technology to host smart contracts called chain code that defines the business rules of the system. And it's designed to support various pluggable components and to accommodate the complexity that exists across the entire economy. This is useful for some of the specific types of transactions like asset ownership change.

5.   **Performance:** As the Hyperledger fabric is a private blockchain network, There is no need to validate the transactions on this network so the transaction speed is faster, resulting in a better performance.

Limitation of Hyperledger Fabric

1.Hyperledger Fabric is a robust and flexible platform for developing blockchain applications, but like any technology, it has certain limitations:

2.**Scalability:** Hyperledger Fabric is designed for permissioned networks, where the participants are known and trusted, which can limit its scalability for large-scale public networks.

Performance: The performance of Hyperledger Fabric can be impacted by factors such as network size, network configuration, and the complexity of chaincode, which can limit its ability to handle high volumes of transactions.

3.**Complexity:** Setting up and configuring a Hyperledger Fabric network can be complex, requiring a deep understanding of the technology and its components.

4.**Compatibility:** Hyperledger Fabric is designed to be used with specific programming languages, such as Go and JavaScript, which can limit its compatibility with other technologies and programming languages.

5.**Cost:** Running a Hyperledger Fabric network requires infrastructure and resources, which can add costs to the deployment and operation of blockchain applications.

Interoperability: Hyperledger Fabric is designed to be used within a single network, and its interoperability with other blockchain platforms is limited.

Hyperledger Fabric Consensus Algorithm

Hyperledger Fabric uses a consensus algorithm to achieve agreement among the participants in a network on the contents of the shared ledger. The consensus algorithm in Hyperledger Fabric is pluggable, which means that it can be replaced with a different algorithm as needed. The most used consensus algorithms in Hyperledger Fabric are:

Practical Byzantine Fault Tolerance (PBFT):

PBFT is a consensus algorithm that provides fault tolerance and reliability in a network. It is wellsuited for networks with a limited number of participants who are trusted and well-known.

RAFT:

RAFT is a consensus algorithm that is used to maintain a consistent state across multiple nodes. It is well-suited for networks where the participants are unknown and potentially untrusted. **Solo:** Solo is a consensus algorithm that is used for testing purposes in a single-node network. It is not suitable for production use.

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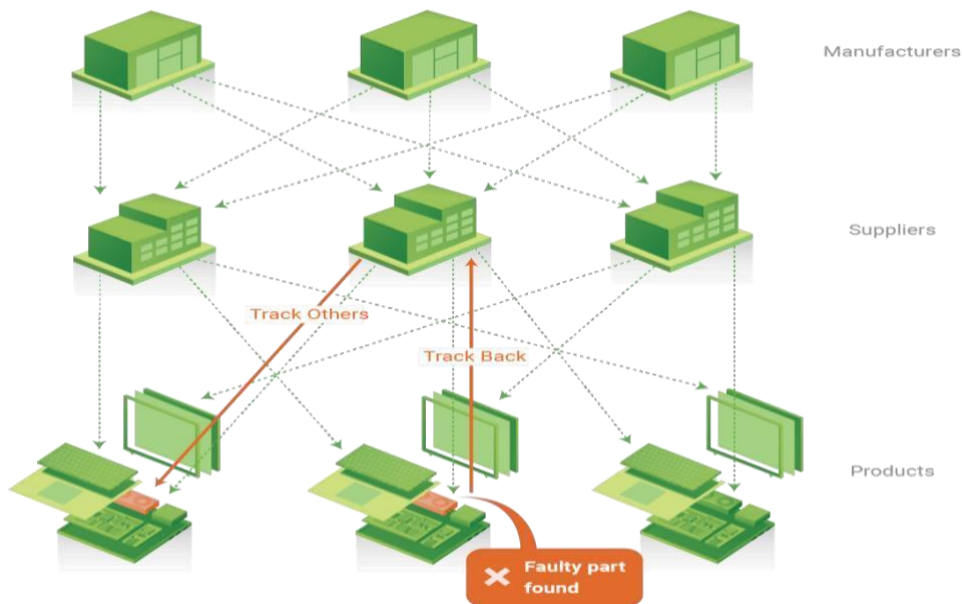
1.Supply Chain

Supply chains are global, distributed webs of suppliers, manufacturers, and retailers. Hyperledger Fabric networks can improve supply chain processes by increasing transparency and traceability of transactions within the network. On a Fabric network, companies with access to the ledger can view the same immutable data, which enforces accountability and reduces the risk for counterfeiting. In addition, production updates are added to the ledger in real time, which makes tracking provenance faster and simpler during events like product recalls or food contamination outbreaks.

2.Trading and Asset Transfer

Trading requires many organizations such as importers, exporters, banks, shipping companies, and customs departments, to work with one another. Using Hyperledger Fabric, financial and trading consortiums can easily create a blockchain network where all parties can transact and process traderelated paperwork electronically, without the need for a central trusted authority. Unlike other processes that require trade-related paperwork to go back and forth between the stakeholders, taking 510 days to complete, transactions in a Hyperledger Fabric network built using Managed Blockchain can process instantly.

3.Insurance

Insurance fraud costs the insurance industry billions of dollars a year, but with Hyperledger Fabric, insurance companies can reference transaction data stored on the ledger to identify duplicate or falsified claims. Blockchain can also make multi-party subrogation claims processing faster by using smart contracts to automate repayment from the at-fault party back to the insurance company. In addition, insurers can use Hyperledger Fabric to streamline Know Your Customer (KYC) processes by storing customer data on a distributed ledger and automating the verification of their identity documents with smart contracts.

4.Banking and Finance
Hyperledger Fabric is also a popular choice for banking and finance applications. The technology allows for secure and transparent financial transactions, reducing the risk of fraud and error. It also enables greater efficiency in payment processing and can help to reduce transaction costs.

5.Healthcare
The healthcare industry is another area where Hyperledger Fabric can be used to great effect. By using the technology to create a secure and private data-sharing network, healthcare providers can share patient information securely and efficiently. This can improve patient outcomes and reduce costs by eliminating redundant tests and treatments.

6.Real Estate

Hyperledger Fabric can also be used in the real estate industry. By creating a secure and transparent system for property transactions, businesses can reduce the risk of fraud and errors in property transfers. It can also help to reduce costs and improve the efficiency of the real estate transaction process.

7.Government

Governments can also benefit from Hyperledger Fabric. By leveraging the technology to create secure and transparent voting systems, governments can reduce the risk of election fraud and improve the accuracy of voting results. It can also be used to create secure and transparent systems for tracking government spending and reducing corruption.
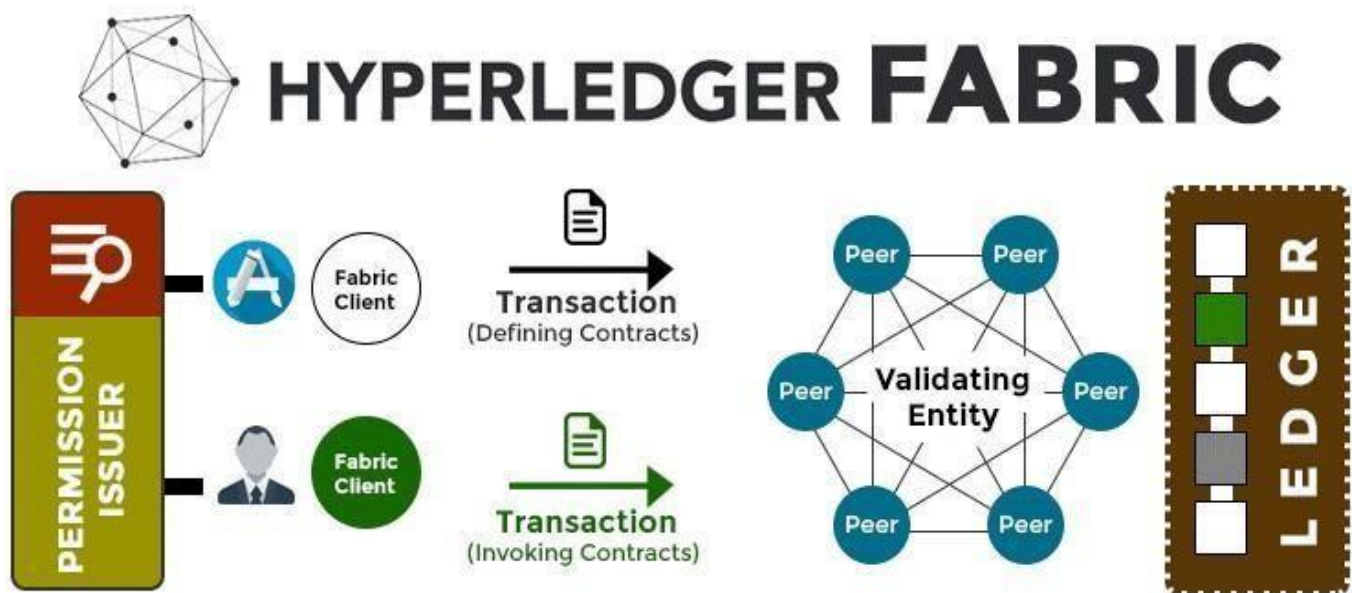
Conclusion : Explore the knowledge of HyperLedger , their features and consensus alogorithm