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Transforming the Supply Chain With Blockchain

Whitepaper

An RPG Company

A supply chain-based system includes entities such as suppliers, manufacturers, packagerss, distributors, and transporters, each managing their own processes and systems. The information stored in these systems (typically legacy systems) is often isolated. Each piece of information may follow different data formats and standards presenting a non-unified view of the information. This results in inconsistencies and difficulties in data collection, sharing, and integration, causing information gaps. The main issues that arise as a result are:

- Inability to track product journeys in real-time, presenting challenges in verifying product authenticity and compliance
- Delays in decision-making and response times that could disrupt production
- Coordination challenges that may result in a lack of trust

This white paper explores the use of blockchain (via distributed ledger technology) to solve the problem of information gaps resulting in issues of traceability, verifying product authenticity, regulatory compliance, and product recall.

It discusses how blockchain provides a network where all stakeholders can form a consortium and securely share information with each other. The information is only stored once it is verified by all the parties and cannot be altered once stored. This builds a system of trust among all parties and provides an ecosystem where the entire product data is available on the ledger, providing visibility and quick access to the information in real time.

Introduction

Supply chains are comprised of several businesses and partnerships that collaborate to handle staff information systems, infrastructure, equipment, and procedures. The aim is to synchronize these components and provide them with what they desire. The primary obstacle, though, is the supply chain's unsynchronized information and physical flows.[1]

Supply chains may face the following challenges:

- **Lack of visibility:** Different record-keeping methods, communication techniques, and geographically dispersed participants hinder accurate traceability. Traceability (the ability to trace the history, application, or location of an object) is critical for ensuring safety, enhancing consumer confidence, and optimizing logistical efficiencies in the supply chain.

- **Complex system with multiple entities:** According to Harvard Business Review, a large organization uses a large number of legacy ERP systems, which differ in data fields and often result in inter-communication issues.[2]

- **Product recall:** Identifying the exact place of origin is important for product recalls as it impacts the economy, brand reputation, and import/export, posing serious risks for health issues.

- **Counterfeiting:** Bad actors within the system can alter the product/information to commit fraud in the supply chain-based ecosystem, harming the brand.

Beyond food safety, consumers, NGOs, governments, suppliers, and buyers are increasingly demanding more information about the origins of products and materials and the conditions under which they were produced and transported along the value chain. With rising demand for organic, fair trade, and environmentally-friendly products and materials, well-functioning traceability systems and new technologies have been developed to meet stakeholder needs.[3]

How is blockchain relevant?

Blockchain enables all stakeholders to share data among members securely and confidentially,

improving collaboration. It allows each transaction and event to create a trusted permanent record that can be used to eliminate disputes and prove compliance when needed. With transparency in the supply chain, consumers can make more informed purchase decisions.

A blockchain-based solution can be used to record product movement with information such as originator, product details, certificate, price, quantity, temperature, location, quality, etc. Storing this information in an immutable ledger builds trust, transparency, and brand reputation by reducing fraud and preventing counterfeiting, enhancing quality control, and enabling efficient product recalls. It also enables better compliance management and regulatory audits.
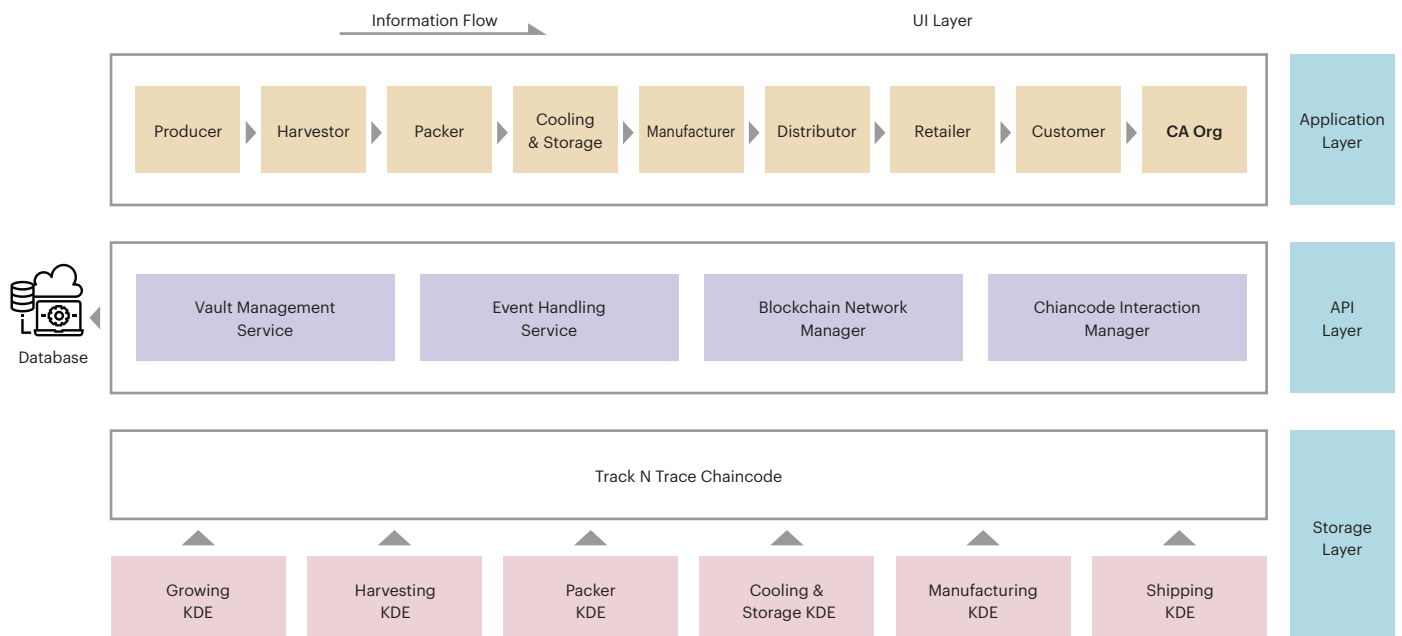
Our proposed approach

Figure 1: System architecture showing modules involved

In the supply chain network above, key players include producers, packers, harvesters, coolers, manufacturers, shippers, distributors, retailers, and end customers.[4] Each operates as an organization within the Hyperledger Fabric network, (an open-source enterprise-grade permissioned distributed ledger technology (DLT) platform providing functionalities such as modular and configurable architecture, smart contract, pluggable consensus protocols, privacy, and confidentiality via channel and PDC), managing their own certificate authority (CA) used to issue the user credentials.[5] Users are issued digital certificates and private keys by their organization CA which are securely stored on the vault service and will be used for blockchain interactions.

Users log in via web UI and perform various operations such as adding product details, adding growing/harvesting/manufacturing KDE (key data elements), creating shipments, and more, according to roles assigned by their organization.

The smart contract will contain defined rules, ensuring only authorized users/organizations can perform necessary functions. This is achieved using access control applied at the contract layer via the use of certificate attributes.

An application backend server is used to interact with the various chain codes to store the KDE. The KDE are specific types of information required by the FDA to accompany shipments, deliveries, or transformation events of products on the FTL for various CTE (critical tracking events or nodes of the food supply chain where food changes hands or changes form) over the ledger.[6] Sensitive or confidential information is securely stored via private data collection (PDC). A cryptographic hash of this information is stored on the ledger for verification purposes.

The network's decentralization is supported by voting policies, and the onboarding of new organizations follows established rules.

Business benefits

This blockchain solution presented above unlocks significant business advantages across the supply chain including:

- **Reliability:** Enables organizations to use blockchain ledger as a reliable, unified source of information, which is immutable and stores information only when all the relevant parties' consent is available.

- **Building trust with transparency:** Eliminates data discrepancies and facilitates accurate forecasting of product delivery schedules. In case of audit or compliance, immutable transactions provide full data history that can be traced back as required. It also fosters customer trust in a brand by enabling a transparent view of the product life cycle flow.

- **Higher efficiency and lower cost with technology enablers:** The blockchain solution can be integrated with AI, ML, IoT, RFID, and smart contracts for transaction recording. This can significantly reduce human error and increase automation, lowering administrative costs.

- **Streamlined process:** Reduces paperwork by creating a digital ledger. Also, data can be quickly retrieved during product recalls and shared with concerned authorities.

Challenges

Although a promising solution, blockchain adoption in supply chains faces a few hurdles:

- **Legacy system:** Existing siloed technologies in supply chain companies make transitioning to a new, interconnected system challenging. Having a proper plan along with a contingency plan to enable integration and provide blockchain benefits will increase the adoption of blockchain.[7]

- **Data analysis:** Understanding and analyzing the vast amounts of data stored on the blockchain is crucial to optimizing processing and storage costs. Proper research and analysis with business experts/subject matter experts to figure out the crucial data to be stored with the right tool usage will be helpful.

Conclusion

In conclusion, this blockchain-based solution, leveraging the Hyperledger Fabric framework, offers a secure and transparent platform for product traceability, authenticity, and product compliance. By enabling trusted data sharing, access control, and smart contracts, it eliminates data inconsistencies and fosters collaboration among participants. However, for optimal success, it's crucial to recognize blockchain as one piece of the puzzle. Integration with complementary technologies such as AI, ML, and IoT, alongside well-defined business requirements, will unlock the full potential of this solution and transform the supply chain landscape.

Reference

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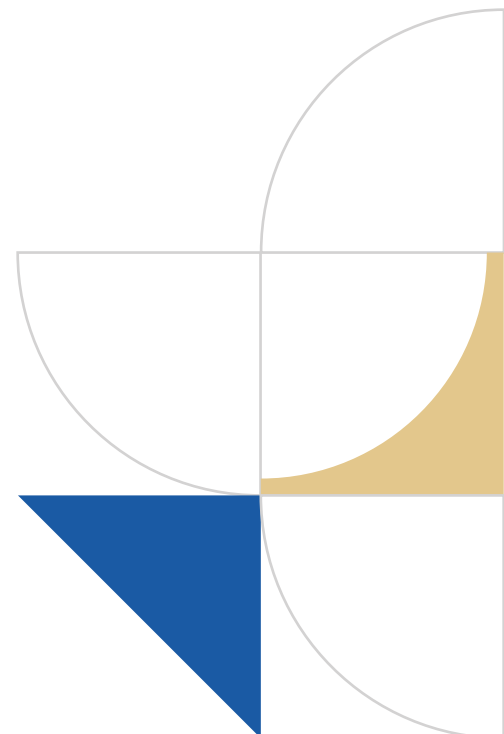
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