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King Fahd University of Petroleum & Minerals

Information & Computer Science Department, King Fahd University of Petroleum and Minerals

ICS 440: Cryptography and Blockchain Applications

Section 1

Project Progress Report

Project Title: Blockchain-Based Supply Chain Tracking System (BSTS)

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- Leader is highlighted.

Introduction

Transparency is a major key in supply chains because it refers to the extent to which all stakeholders, suppliers, distributors and even customers can see and verify the flow of goods, information and processes across the entire supply chain. This gives the user a chance to visible the product movement, accuracy and integrity of the data. This major key prevents fraud, counterfeiting and builds trust in the network. Fraud and counterfeiting are affecting the process because it might lead to manipulation of records, or substitution of personal goods. Transparency and clearance in the supply chain prevents these and eliminates the trust issues that might arise.

Among the features that blockchain should account for is the immutability and the traceability of a record. Blockchain provides immutability by maintaining the recorded data on the blockchain unchanged and cannot be deleted. This ensures a tamper-proof log of all supply chain events, from raw material sourcing to final product delivery. Additionally, blockchain provides traceability by allowing each record or item in our case to be tracked at every stage using a unique digital identity. All transactions and movements are recorded and securely linked to previous records which create eventually a trusted history for participants.

Transparency is achieved using a blockchain through decentralized data storage by giving stakeholders a shared view of the supply chain. No need to rely on a single authority, all parties can verify the integrity and authenticity of data independently. As mentioned in the first paragraph, this visibility reduces disputes, increases overall confidence and improves coordination in the system.

Key benefits of the BSTS include improving transparency, increasing the trust between participants and the system, reducing the fraud and counterfeiting, enhancing the traceability and immutability of the records. The purpose of it is to address challenges of trust by establishing a transparent, secure and trustworthy supply chain ecosystem.

System Design and Architecture

This project implements a simple supply-chain tracking dApp where producers publish products on Ethereum, suppliers/retailers purchase them, and consumers can verify the product history by scanning a QR code.

1. Workflow: producer–supplier–consumer–smart contract

The end-to-end workflow of the proposed BSTS is illustrated in Fig. 1.1.

At a high level:

- **Product registration:** The producer opens the Add Product page, enters product details, and confirms a registerProduct transaction via MetaMask. The smart contract stores the product on-chain, and the app later generates a QRcode linked to its identifier.
- **Purchase and ownership transfer:** The supplier views the list of approved products and clicks Buy. The dApp sends a payable transferProduct transaction through MetaMask. On success, the contract updates the product owner and credits the seller's internal balance.
- **QR-based verification:** The consumer scans the QR code, which opens a product page containing the product identifier. The dApp calls getProductHistory(productId) and displays the origin and transfer history returned by the smart contract.
- **Balance withdrawal:** A producer or supplier can withdraw their accumulated balance by clicking Withdraw Balance. The dApp issues a withdrawBalance transaction via MetaMask, and the contract transfers the corresponding Ether to the user's wallet.

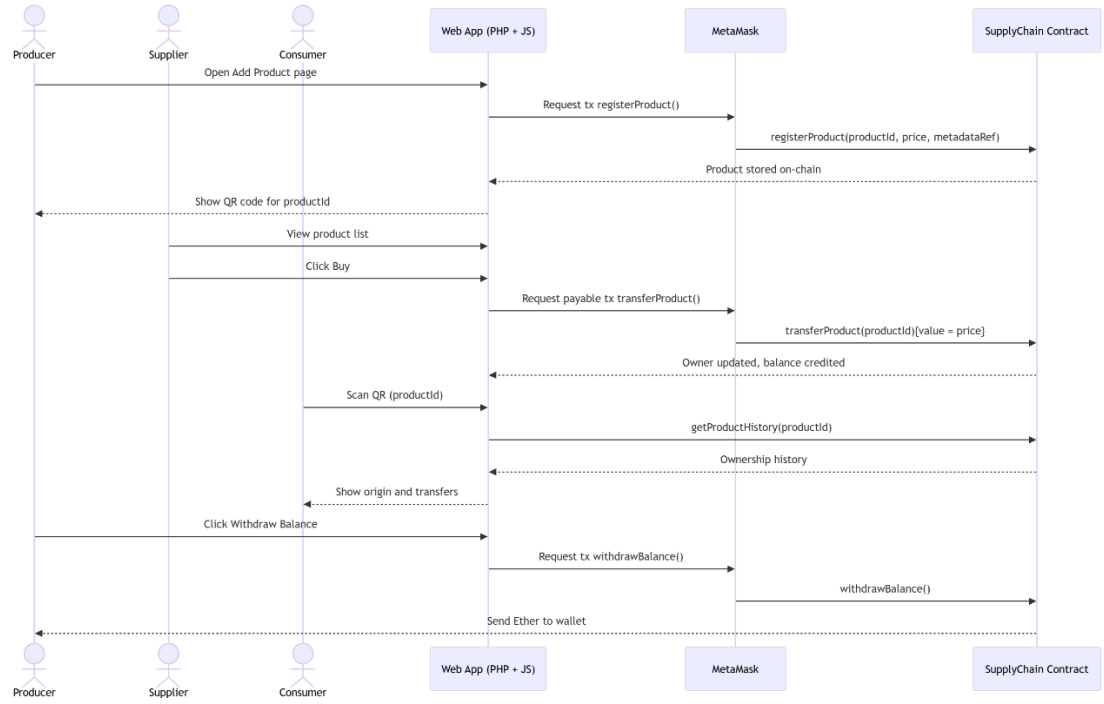

Fig. 1.1. Sequence diagram of the BSTS workflow showing interactions between producer, supplier, consumer, web application, MetaMask, and the supply-chain smart contract.

2. Functional Modules

The Blockchain-Based Supply Chain Tracking System (BSTS) is decomposed into a small set of modules; the main components and their interactions are summarized in Fig. 1.2.

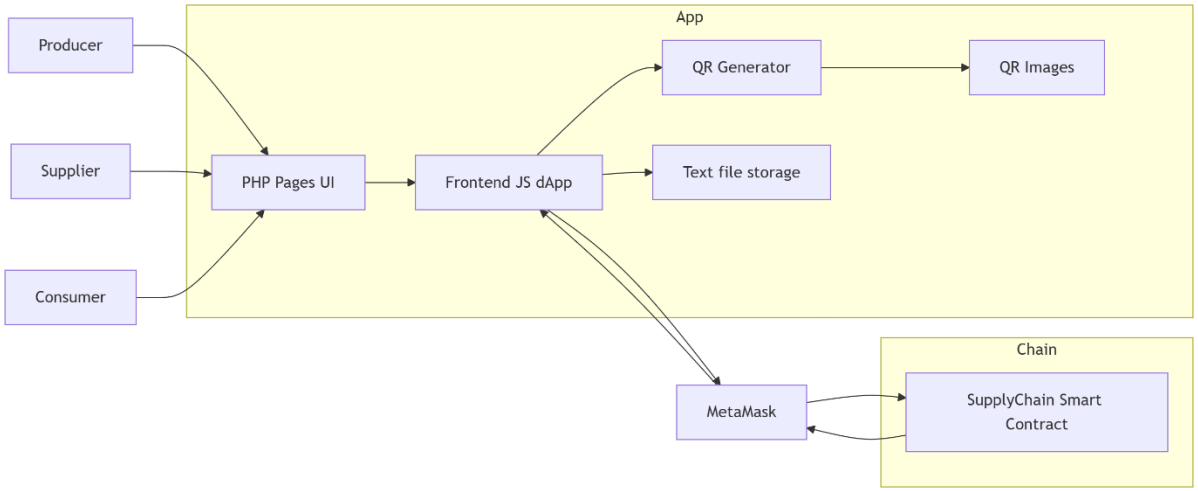

Fig. 1.2. System architecture and main functional modules.

- **User layer:** Producers, suppliers/retailers, and consumers access the system through a standard web browser.
- **Client (browser) layer**
  - **PHP Pages UI:** screens for login, product registration, product details…
  - **Frontend JS dApp:** connects the UI to MetaMask, sends registerProduct, withdrawBalance, and performs read-only calls such as getProductHistory.
- **Blockchain access layer (MetaMask):** Manages user accounts, signs transactions and forwards them to the Ethereum testnet.
- **QR and file layer:** The QR generator creates QR codes for registered products, and QR storage keeps the images so they can be shown or printed.

3. Technology stack

- **Blockchain layer**
  - Ethereum-compatible test network (Sepolia)
  - Smart contracts written in **Solidity** and deployed via **Remix IDE**
- **Wallet and dApp interaction**
  - **MetaMask** browser extension for transaction signing
  - **Sepolia Etherscan** to verify and visualize transactions.
- **Web and backend**
  - **XAMPP** stack running locally: Apache + PHP on localhost
  - PHP for routing, simple authentication, QR generation
  - Text files will be used for data sotrage