Blockchain for Smart Healthcare

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Project Overview/Goals

The 2013 Drug Supply Chain Security Act has noted the dire need to overhaul the pharmaceutical supply chain.

Key goals:

- Store results of tests on pharmaceutical pills (hardness, density, scans)
- Track the movement of pharmaceutical pill through the supply chain
- Have the ability to link results of test to these various pill shipments
- Maintain privacy of data and transactions

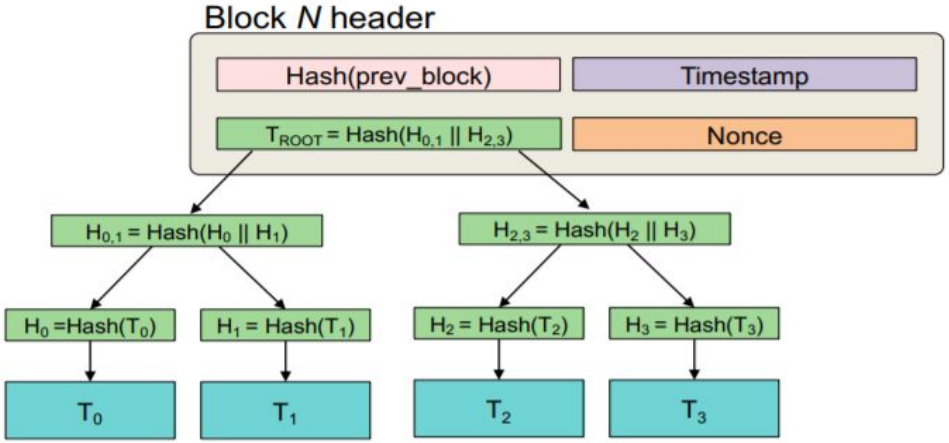
What is a blockchain?

“A continuously growing list of records linked and secured by mathematical techniques”

Beneficial Qualities:

- Immutable because of math
- “Continuously growing”
- Easily accessible by everyone

What is a blockchain?



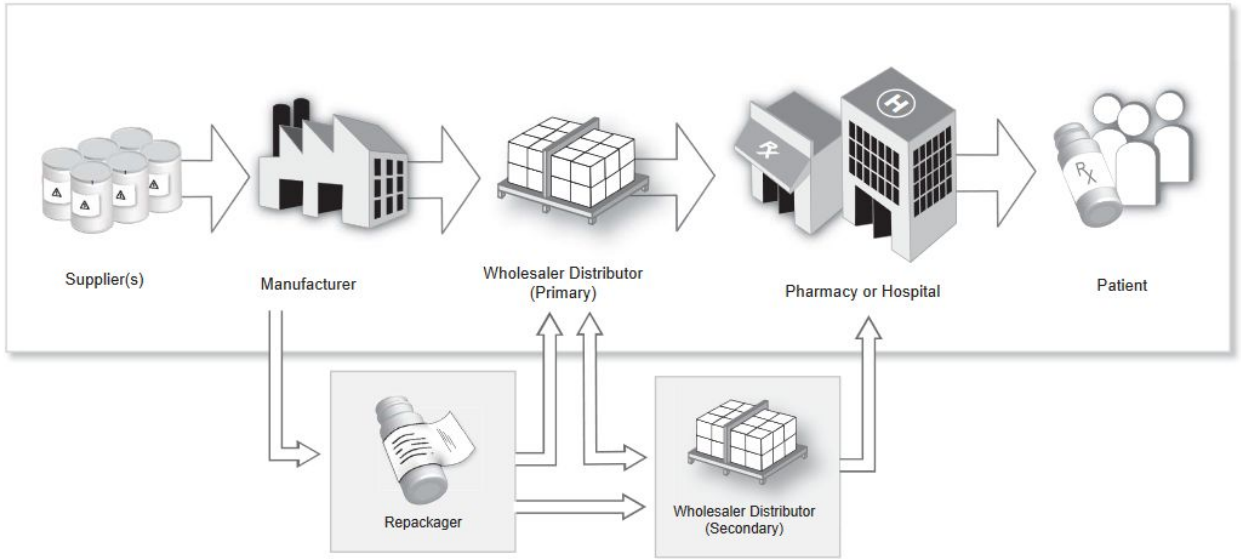
- Chain of blocks linked by hash pointers (unique codes) to previous blocks
- Transactions stored inside block headers
- Hash Function: one-way function that maps data of any size into a set size of bits

Pharmaceutical Supply Chain

FDA

A Drug Supply Chain Example

From Supplier to Patient



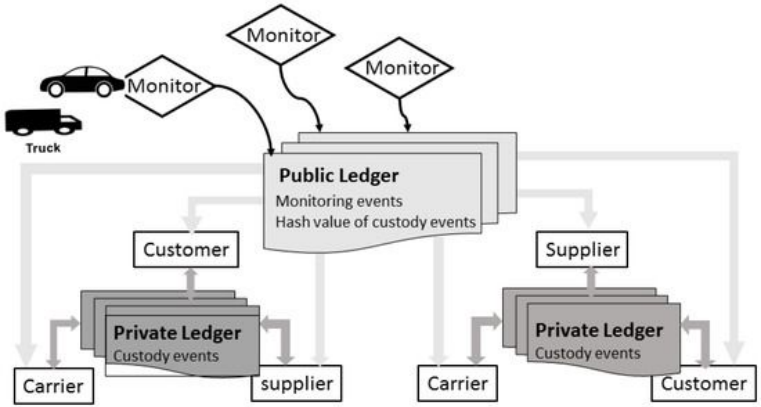
Hyperledger Fabric Architecture

- Each channel has its own blockchain (ledger) and world state
- Ledger records every access and change to the world state
- Access to values can be built into the operation of the channel

Step-by-step:

1. An actor on a channel can report a transaction (Ex. Merck made 100 pills, RWJ bought 40 containers)
2. The blockchain stores this transaction on a block
3. The world state may be recording how many pills were made, and updates after seeing transactions

Concept 0



In the paper:

- Monitors and other triggers can send events that update the blockchains
- Certain updates in the private ledger reflect in the public blockchain

Our idea: Channels to separate and record different data

- Everyone in the network: records whenever shipment sent/received
- FDA to manufacturer: results of drug tests
- Manufacturer to Wholesalers: transaction and shipment details
- Wholesalers to Customers: transaction and shipment details

Concept 1

Use an Access Control Matrix to control the actions one could make and data one could access

- Actors: FDA, Manufacturers, Wholesalers, Customers
- Actions: Read, Initialize, Edit/Update, Delete
- Characteristics: Maker, Owner, Drug Type, Container ID, Timestamp, Expiration Date, Test Results, Pill/Container, Price, Location

Concept 1

	Maker	Pills/ Cont	Type	ID	Time	Expire	Results	Owner	Price	Loc
FDA	r	r	r	r	r	r	r,e	r		
M	i	i	i	r,i	i	i	i	i,e	r,i,e	i,e
W	r	r	r	r		r	r	r,e	r,e	r,e
C	r	r	r	r		r	r	r	r	r

Key Ideas not shown in matrix:

- Ownership changed through smart contracts
- Location cannot be read once in a customer's possession
- Only FDA can delete data from database

Hyperledger Fabric Set-up

- cURL
  - Data transfer w/ command line interface
  - Installing Hyperledger packages
- Docker
  - Container platform; create runtime environment for ledgers
- Go
  - Used to interface with Hyperledger
- Node.js
  - Handle javascript dependencies outside of browser

Progress and Future Work

- Downloaded a sample blockchain network to work with, making sure that all parts are working as intended
- Creating our own network, writing chaincode to mirror the authorization of transactions listed in the Access Control Matrix