



Applying Blockchain to the Healthcare Industry

Potential use cases and a working prototype

—Mike Myburgh, Principal Consultant, Office of the CTO, TIBCO

STRENGTH IN NUMBERS

Blockchain is a way of recording information, such as health information and its provenance, on a distributed ledger that cannot be modified after it has been written. When you upload information (an asset or a transaction), you assign it a unique identifier so it can be traced back to you and secured into a block. When new blocks are added, all of the nodes in the network update their version of the blockchain to include the new assets. In this way, the network overpowers attempts to enter or confirm false blocks.

Now you have the ability to confidently transfer your asset to anyone. Each time it changes hands, the transaction is written to the blockchain to show new ownership. The new owner(s) can trace previous ownership all the way back to the creator.

Bitcoin has taken the world by storm, last year increasing its value by roughly 2,000%. It's an amazing story, but what is even more amazing is the blockchain technology behind it, which allows transactions to be validated and consensus reached by nodes in the network without any intermediaries.

To stay competitive today, healthcare organizations have to apply ground-breaking solutions to age old problems. Of course, many industries can leverage ground-breaking solutions, but healthcare is unique in its very broad and varied ecosystem, which could be helped by blockchain.

Some potential use cases:

- **Cost reduction and cybersecurity.** Healthcare data is a prime target for theft because it tends to include enough information to allow a criminal to open a credit card, bank account, or loan in the victim's name—or to use ransomware to extort healthcare organizations for money. In 2015 over 113 million Americans' health records were exposed, and in 2016 the number was over 16 million according to reports submitted to the U.S. Department of Health and Human Service's Office for Civil Rights. A March 2017 report from the Identity Theft Resource Center indicated that more than 25% of all data breaches were related to healthcare. The estimated loss to the industry is \$5.6 billion per year.¹

PROTOTYPE USE CASE AND REFERENCE ARCHITECTURE

For a description of a general enterprise blockchain reference architecture, please see the whitepaper located at: <https://www.tibco.com/resources/whitepaper/whitepaper-adopting-blockchain-enterprise-architectures-key-considerations-and-> The prototype described in this paper is based on this general reference architecture, and describes a use case specific to the healthcare industry.

- **Personalized treatment and information accessibility.** Digitization of care delivery, and increasing pressure to decrease healthcare costs, are transitioning the industry toward more personalized treatment. To make this possible, health systems, payers, and drug and device manufacturers need a secure and connected health IT ecosystem to manage patient information and promote value-based care. Industry leaders have stated that blockchain offers the potential to improve and authenticate the delivery of services by sharing records securely, according to exact rules.²
- **Patient empowerment.** Using blockchain technology, patients could control their personal health and medical information to make sure it was accurate and grant access to it.^{3,4} Where until now, patients were neither incentivized nor able to do this, by implementing a blockchain token system linked to healthcare services, both research facilities and patients would benefit. Research would be assured of accurate data, patients would receive services in exchange for their accurate data.

While it isn't a healthcare panacea, blockchain has the potential to save billions of dollars by optimizing current workflows and rendering some high-cost gatekeepers obsolete.

SAMPLE USE CASE

Suffice it to say that there are many ways that blockchain can be used to solve at least some of the problems we face today. To illustrate, let's look at a couple of steps in the medical claims process involving multiple parties from different organizations, as well as the patient who is not related to any organization. By its nature, the process is fragmented and requires several integration touchpoints. Blockchain is very good at solving problems that involve fragmented systems. A simple dental claim scenario:

- A dentist submits a claim to a patient's insurance provider for services provided.
- An auditor at the insurance company checks the claim's correctness and determines the amount that needs to be paid based on the patient's policy.
- After the auditor approves the claim, they forward it to accounts payable to pay the amount owed to the dentist.

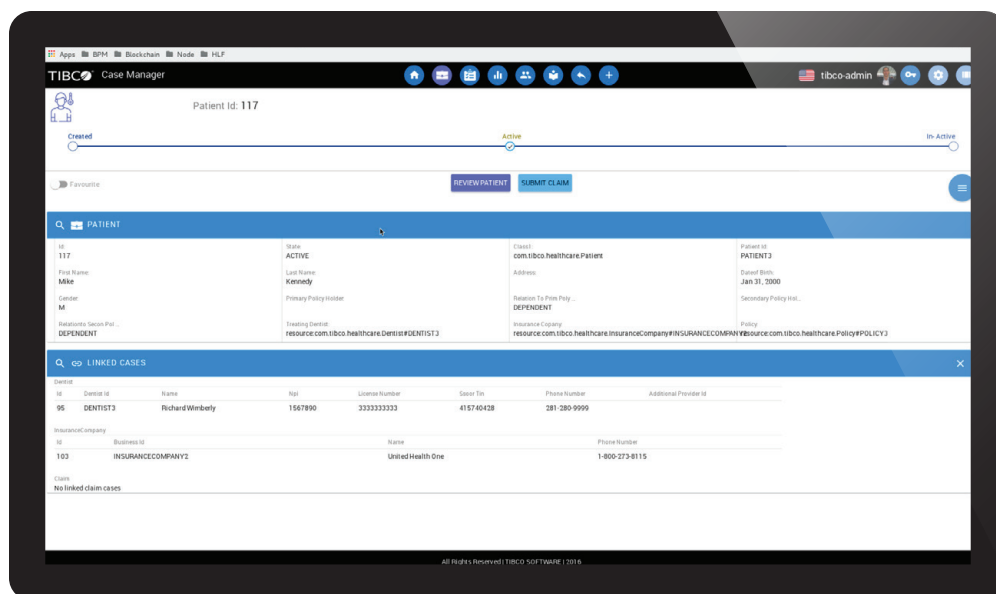
Here's the scenario with blockchain applied:

- A dentist submits a claim for services provided to an insurer's blockchain.
- Uploading the claim triggers a *smart contract** with programmed business rules that audit the claim and determine the amount to be paid.
- When the audit completes, it triggers an event that causes the claim to be paid based on the smart contract's business rules for the claim type.

What's different?

- Other than the initial claim submission, no humans are involved, reducing friction, speeding resolution, and costing less. Transaction errors and missing information are reduced.
- An immutable audit trail is created that allows anyone with the correct privileges to view the claim's lifecycle.
- The process also secures data elements because every transaction is encrypted with the blockchain member's key. Thus, a cybercriminal would need access to each blockchain member's key to access all the transaction data.

*Blockchain smart contracts are programs that automate business transactions, usually written in JavaScript for Hyperledger Fabric, and in Solidity for Ethereum.



Audit trail showing the life of the claim with links and relevant information in TIBCO® Case Manager.

CHALLENGES AND CONSIDERATIONS

Blockchain is nascent technology, so experience and implementations are as yet few. There are, however, a number of issues to be considered when planning a blockchain solution—which our working use case prototype (described under SOLUTION COMPONENTS/ARCHITECTURE below) addresses.

REGULATORY COMPLIANCE

In Healthcare, regulations and standards dictate many processes. None of these have been setup in blockchain implementations—but blockchain could help with regulatory compliance. Rules could be built into smart contracts that ensure that regulations are adhered to, but smart contracts need to be programmed. (See Smart Contracts and TIBCO BusinessEvents® under SOLUTION COMPONENTS/ARCHITECTURE below.)

ACCESS MANAGEMENT

Data privacy in healthcare is a huge concern, and blockchain can offer a solution. Access management ensures that the right people have access to the required information and prevents others from gaining access.

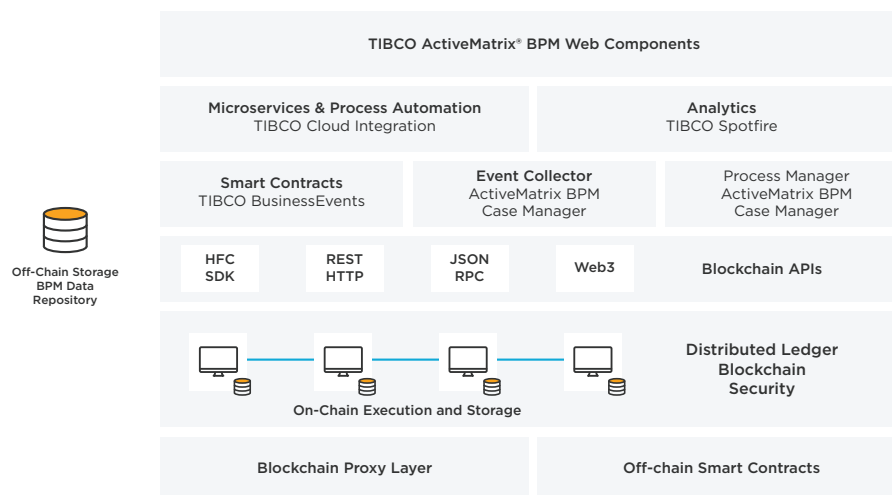
SYSTEMS INTEGRATION

Integration is an important consideration when planning a blockchain implementation. Current blockchain technologies, which employ APIs, provide integration touchpoints for connecting other systems. These need to be managed and exposed so they're easy to use. API management and microservices solve this problem.

VISIBILITY

Transaction data is securely hashed and stored in blocks on a chain—and it's quite difficult to get to the data and visualize the end-to-end transaction flow. Implementing a solution that combines blockchain and business-process or case management makes it much easier to visualize transaction flow.

PROPOSED SOLUTION COMPONENTS/ARCHITECTURE



Future work will include integrating other systems, and continuing to test and experiment to make this example as useful as possible.

USER INTERFACE — BUSINESS PROCESS MANAGEMENT

A blockchain records transactions, and in our solution, TIBCO ActiveMatrix® BPM with case management capabilities is the front-end and process orchestrator. The blockchain is hidden while end users easily navigate and interact with linked cases (patients, claims, providers, insurance companies), and execute transactions among participants.

Collaboration is an important component of case management. ActiveMatrix BPM allows for recording the business interaction between patients, payers, and providers. This kind of information does not need to be stored on the blockchain, and there are several ways to record off-chain data depending on the specific scenario. In this case, ActiveMatrix BPM provides off-chain storage for collaboration and the business audit trail, and blockchain securely records the provenance and information about claims and payment events. When an asset is created on the blockchain, it receives a unique id, which is used to link on-chain assets to off-chain data elements.

VISUAL ANALYTICS

Through TIBCO Spotfire®, the solution provides visual analytics to allow payers to see information on patients, claims, and providers involved in transactions.

INTEGRATION

The TIBCO integration layer exchanges information between ActiveMatrix BPM and other line of business systems. In our solution, TIBCO Cloud™ Integration and TIBCO Mashery® API management can be used to manage all blockchain APIs.

BLOCKCHAIN TECHNOLOGY

The blockchain network used in this solution is Hyperledger Fabric. Most mainstream blockchain solutions like Ethereum, Corda, and others, provide capabilities for a solution like this, including the ability to develop applications or solutions using a modular architecture. One of the big promises of blockchain is smart contracts. Hyperledger Fabric calls these chaincode. Ethereum has similar capabilities. Smart contracts are intended to facilitate, verify, and enforce the negotiation or performance of a contract.

ACCESS CONTROL

We used ActiveMatrix BPM to manage access control because it provides a business-user friendly design time for quick and easy access to change user permissions. Most blockchain solutions also provide access management capabilities, but can slow down your backend system. Instead, we decided to use blockchain for its strengths: provenance, data security, streamlined validation and consensus.

ASSETS, PARTICIPANTS, AND TRANSACTIONS

Blockchain works on a principle of assets (policies, claims), participants (patients, providers, insurance companies), and transactions (submit claim, update claim, audit claim). Every time an asset, participant, or transaction is created, updated, or deleted, the blockchain records the event and adds it to the immutable audit trail on the distributed ledger.

EVENTS

Blockchain can be configured to emit events on a message bus. These events can be consumed by external systems like TIBCO BusinessEvents®. In our solution, we use TIBCO BusinessEvents Streaming Analytics as an off-chain smart contract management component and allow business users to model instead of code their smart contract into the blockchain.

SUMMARY

Enterprise blockchains hold exciting promise for various industry applications, but especially healthcare. The ability to curb fraud by securing data on the blockchain, provide insight to patients about their health records, and substantially reduce the cost of transactions by eliminating intermediaries would be far-reaching. As stated, blockchain is not the answer to every problem, but it is certainly worth examining for the healthcare industry.

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ADDITIONAL REFERENCES

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Global Headquarters
3307 Hillview Avenue
Palo Alto, CA 94304
+1 650-846-1000 TEL
+1 800-420-8450
+1 650-846-1005 FAX
www.tibco.com

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