



ARCHITECTING BLOCKCHAIN SOLUTION

Course:

Topic: Architecting Blockchain
Solution

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LEARNING OUTCOMES

- Session 1
 - Understand how blockchain can be used to design applications
 - Understand when blockchain is not a natural fit for an application
 - Understand the UPSTAC application and build it from scratch
- Session 2
 - Understand and apply architectural patterns on UPSTAC
 - Recall Fabric components and build the Fabric network for UPSTAC
- Session 3
 - Understand and recall chaincode basics
 - Write chaincode for UPSTAC application

LEARNING OUTCOMES

- Session 4
 - Understand the API server layer of the UPSTAC application
 - Understand and implement Express.js to write APIs for UPSTAC
- Session 5
 - Understand the deployment issues for UPSTAC
 - Deploy UPSTAC on cloud
- Session 6
 - Understand blockchain managed services and different products of it
 - Understand Caliper as a performance measurement tool and implement it for UPSTAC

TODAY'S AGENDA

- **Blockchain Recap**

- What are the fundamental properties of blockchain?
- What are the advantages blockchain technology?
- What are the limitations of blockchain technology?
- What is the difference between public and private blockchains?
- What is the difference between conventional database and blockchains?
- In which areas is decentralisation advantageous?

TODAY'S AGENDA (contd.)

- Use cases for centralised applications
- Use cases for decentralised applications
- UPSTAC application
 - User stories
 - Current solution architecture without blockchain
 - Updated architecture with blockchain

Blockchain Recap

- Let us start with: Why blockchain?
- The answer to this question is a very good starting point for building any application.
- Like any emerging technology, blockchain is portrayed as a technology that would end all the suffering for application developers as well as users.
- However, that is never the case with any technology.
- A new technology rides on hype cycle before it undergoes a reality check. This follows more fundamental and grounded work.

Let's take the example of Big Data. For earlier part of last decade, this technology was considered to be a death nail to conventional database systems. But did that happen? Absolutely not. The two technologies have since been working in tandem and complementing each other.

Same is the case with blockchain. Blockchain itself is not going to replace all the centralised database-based solutions, but it will work in tandem with them.

So, you should always ask some fundamental questions while building a blockchain-based solution.

- Why blockchain?
- What are the advantages of a decentralised solution over a centralised one?
- How is blockchain technology the right fit for a given use case?
- Is the whole solution built using this technology or only a part of it?
- Which blockchain technology can be used here?

In subsequent sections, these questions will be answered.

- Secure and reliable
- Provides a trustless system
- Disintermediation
- Improved traceability and transparency
- Immutability

- Scalability
- Low throughput
- High transaction cost
- Integration and interoperability
- Inefficient storage and data redundancy

PUBLIC vs PRIVATE BLOCKCHAINS

Public Blockchain	Private Blockchain
<ul style="list-style-type: none">• Access is open to all	<ul style="list-style-type: none">• Access is restricted to participating organisations
<ul style="list-style-type: none">• No single entity controls the network	<ul style="list-style-type: none">• One or more entities control the network
<ul style="list-style-type: none">• Slower transaction speed	<ul style="list-style-type: none">• Higher transaction speed
<ul style="list-style-type: none">• Ethereum	<ul style="list-style-type: none">• Hyperledger Fabric

Centralised storage	Distributed ledger
<ul style="list-style-type: none">● Data is not stored in uniform sized blocks	<ul style="list-style-type: none">● Data is stored in uniform sized blocks
<ul style="list-style-type: none">● Centralised administration	<ul style="list-style-type: none">● Decentralised; data is stored on each participating node
<ul style="list-style-type: none">● Supports CRUD operations	<ul style="list-style-type: none">● Supports read and write operations
<ul style="list-style-type: none">● Data is not persistent	<ul style="list-style-type: none">● Immutable

Centralised storage	Distributed ledger
<ul style="list-style-type: none">● Uses client-server architecture	<ul style="list-style-type: none">● Peer-to-peer architecture
<ul style="list-style-type: none">● Prone to failures and data corruption	<ul style="list-style-type: none">● Ensures data integrity
<ul style="list-style-type: none">● Supports fast operations	<ul style="list-style-type: none">● Lower throughput because of consensus
<ul style="list-style-type: none">● Cost-effective and easy to implement	<ul style="list-style-type: none">● Harder to implement; higher cost due to data redundancy

- Blockchain, as a technology, has brought in a different perspective to building applications.
- This does not mean that technology can be used to build every application.
- There is a difference between use cases where it is required and desirable.
- It is important to analyse the requirement of blockchain based on strengths and weaknesses of this technology.

Poll 1 (15 seconds)

Which of the following properties are unique to blockchain?

- A. Consensus mechanism
- B. Client-server architecture
- C. Trust
- D. Higher transaction throughput

Poll 1 (15 seconds)

Which of the following properties are unique to blockchain?

- A. **Consensus mechanism**
- B. Client-server architecture
- C. **Trust**
- D. Higher transaction throughput

- Because of nature and limitations of blockchain technology, there are cases where use of blockchain technology is not advisable.
 - Applications that require high throughput
 - E-commerce platform, such as Amazon
 - Internal applications to an enterprise
 - HR reporting tool
 - Standalone applications
 - Image editor

- Because of its inherent properties, blockchain is a natural fit for some applications.
 - Applications where trust is important (**Exchanges, Payments**)
 - Business to business transactions (**Supply chain applications**)
 - Application that deal with asset ownership and transfer (**NFTs**)
 - Decentralised applications (**DeFi currency exchange**)

- Because of its inherent properties, blockchain is natural fit for some applications, but not all applications can be built on all types of blockchains.
- There are some applications like B2B enterprise solutions that require some amount of privacy and restrictions. As a result, a permissioned or private network is better suited.
- Public blockchains are more suitable for some applications where transparency is more important, B2C applications, like the ones involving asset ownership and transfer.

How does introduction of blockchains change conventional solutions?

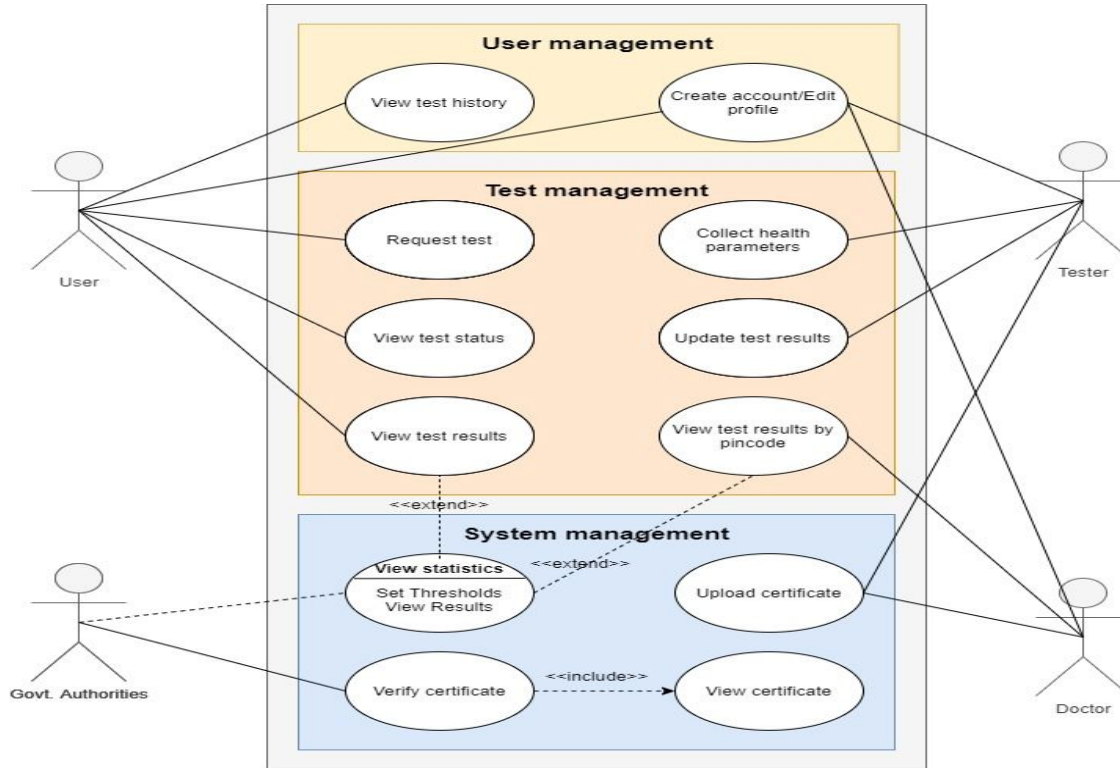
- Does it make them useless?
- Does it replace any current elements?
- Does it modify any of the current elements?

- We have a system for user registration where patients can sign up and request tests, lab technicians can upload results, results can be accessed by doctors and governments for cross verification.
- The relevant insurance companies can also access this portal to verify the claims made by patients and hospitals.
- Let us see how blockchain can be used in this solution and what value it will add.

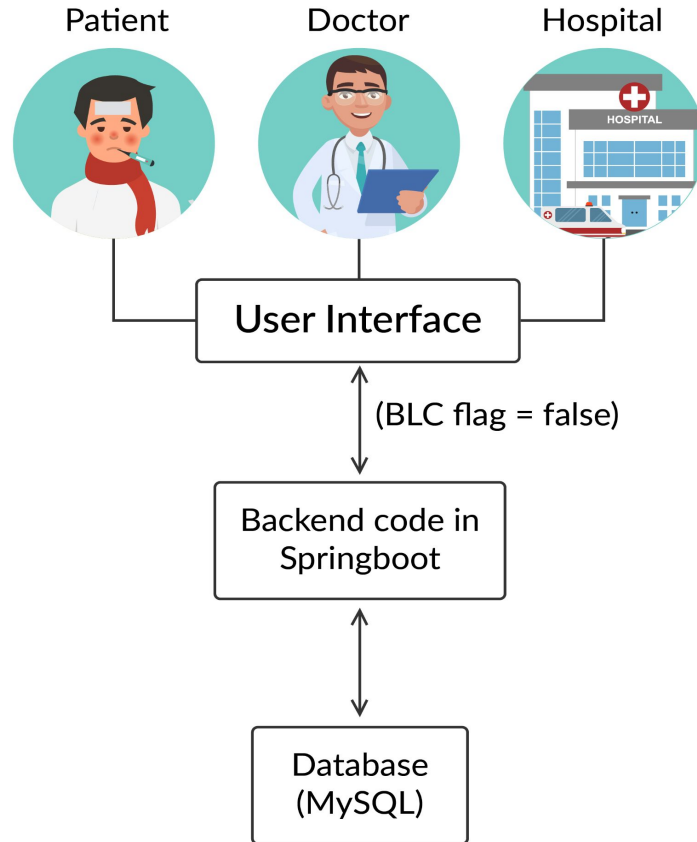
- Individual users
- Hospitals and Labs
- Government
- Insurance agencies

- User/Patient
 - Register new patient
 - Login as registered user
 - Request for new test
 - View results for requested tests
- Tester
 - Register as tester
 - Login as registered user
 - Check and filter test requests
 - Update test results

- Doctors
 - Register as new doctor
 - Login as registered user
 - View test results of patients
 - Update patient status based on test results
- Government Authorities
 - Register as a government user
 - Login as registered user
 - View test requests and results



Present UPSTAC Solution

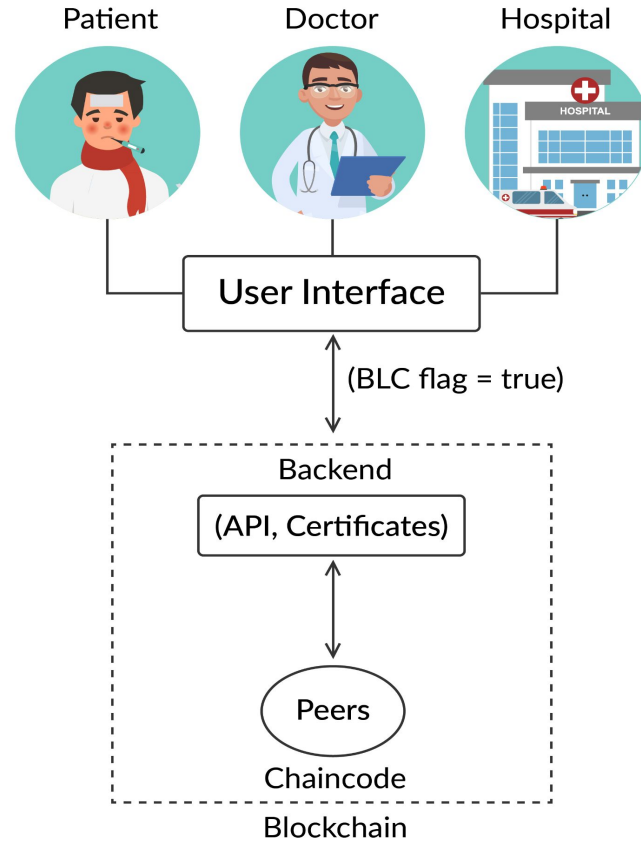


- In the proposed application, patient data needs to be maintained.
- This data is shared between users, hospitals, government and insurance agencies in some cases.
- In a centralised system, it is not easy to maintain patient records and ensure trust in the system.

- Patients visit many hospitals and each hospital maintains data of its own. So, it is difficult to keep track of patient records
- Bringing together different hospitals on a centralised system cannot be a solution, as the database is in the custody of one administrator, and hence, can be tampered. Also business, logic can be altered in the system.
- Data is scattered across different systems, due to which it is not easily available.

- On a public blockchain like ethereum, data is accessible to everyone.
- Storing personal data like medical records leads to breach of user privacy.
- Permissioned blockchain network is more useful as data access can be restricted.
- The given problems can be solved using Hyperledger Fabric blockchain, which will enable transparency, immutability, availability and trust.

- Databases are immutable, which enables trust in the system.
- Business logic cannot be altered without consensus between all organisations.
- Insurance companies can audit the data in a trusted manner.
- Test results and treatment data can be shared between hospitals.



Poll 3 (15 seconds)

Who are the participating organisations of UPSTAC application?



Poll 3 (15 seconds)

Who are the participating organisations of UPSTAC application?

- A. Hospitals
- B. Government agencies
- C. Insurance agencies

CONSIDERATIONS FOR DATA STORAGE ON BLOCKCHAIN

- Redundancy should be considered, as same data is stored on all the nodes. It increases the cost of data storage.
- When it comes to public blockchain, data is accessible to all. So, personal data cannot be stored on blockchain.
- In case of permissioned blockchain, like HL Fabric, data can be accessed by all the nodes in a channel.
- Privacy regulations of individual countries
- Business and competitive secrets

- Store hash of data on blockchain and actual data in off chain sources.
- Store only some of the data on blockchain and the rest in the off chain.
- In case of HL fabric, use channels for privacy. In this approach, data will not be stored in all the peer nodes.
- Store transactional and event data off chain so that it can be accessed easily.

In this class, you learnt

1. What are the properties of blockchain?
2. What advantages does blockchain technology provide?
3. What are the limitations of blockchain technology?
4. How blockchain is different from conventional database?
5. What is the difference between public and private blockchain?
6. What are some sample use cases of blockchain technology?
7. User stories of UPSTAC application.
8. User personas and organisations involved.
9. Updated solution design for UPSTAC application (using blockchain).

Let's look at following use cases and apply learnings to identify how to design the solution architecture.

1. HR reporting tool
2. Inventory management in a supply chain
3. Land Registry system

Use the following questions as guidelines:

1. Is blockchain suitable for the application? Why or Why not?
2. Which type of blockchain is more suitable?
3. Can database be used in conjunction with blockchain?
4. How will the overall block diagram of the application look like?

NEXT STEPS

Do the homework exercise for UPSTAC solution.



Thank You!