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Patient Data Management Using Hyperledger Fabric

Team Titanium - Final Presentation

Frankfurt University of Applied Sciences

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Agenda

Introduction

- Motivation
- Hyperledger Fabric as Healthcare System

Project Design and Implementation

- Architecture
- Smart contracts and Chaincode
- Software Development Kit
- Security

Drawbacks and Conclusion

- Drawbacks
- Conclusion

Hyperledger Fabric Introduction

Hyperledger Fabric provides a permissioned immutable distributed ledger network for enterprises to carry out public as well as confidential transactions within the same network.

Motivation

- Interoperability of a patient's medical history
- Privacy and security of electronic health records.
- Auditable and resistant to tampering.
- A patient-centric system

Hyperledger Fabric as Healthcare System

- Trustworthy platform, integrity of health records
- Decentralization of Health Records
- High-level security by authorization

Architecture

- Channel, consortium
- MSP and CA
- peers, distributed ledger, chaincode
- Ordering service, endorsment policy
- actors, and a web application

Patient Data management System

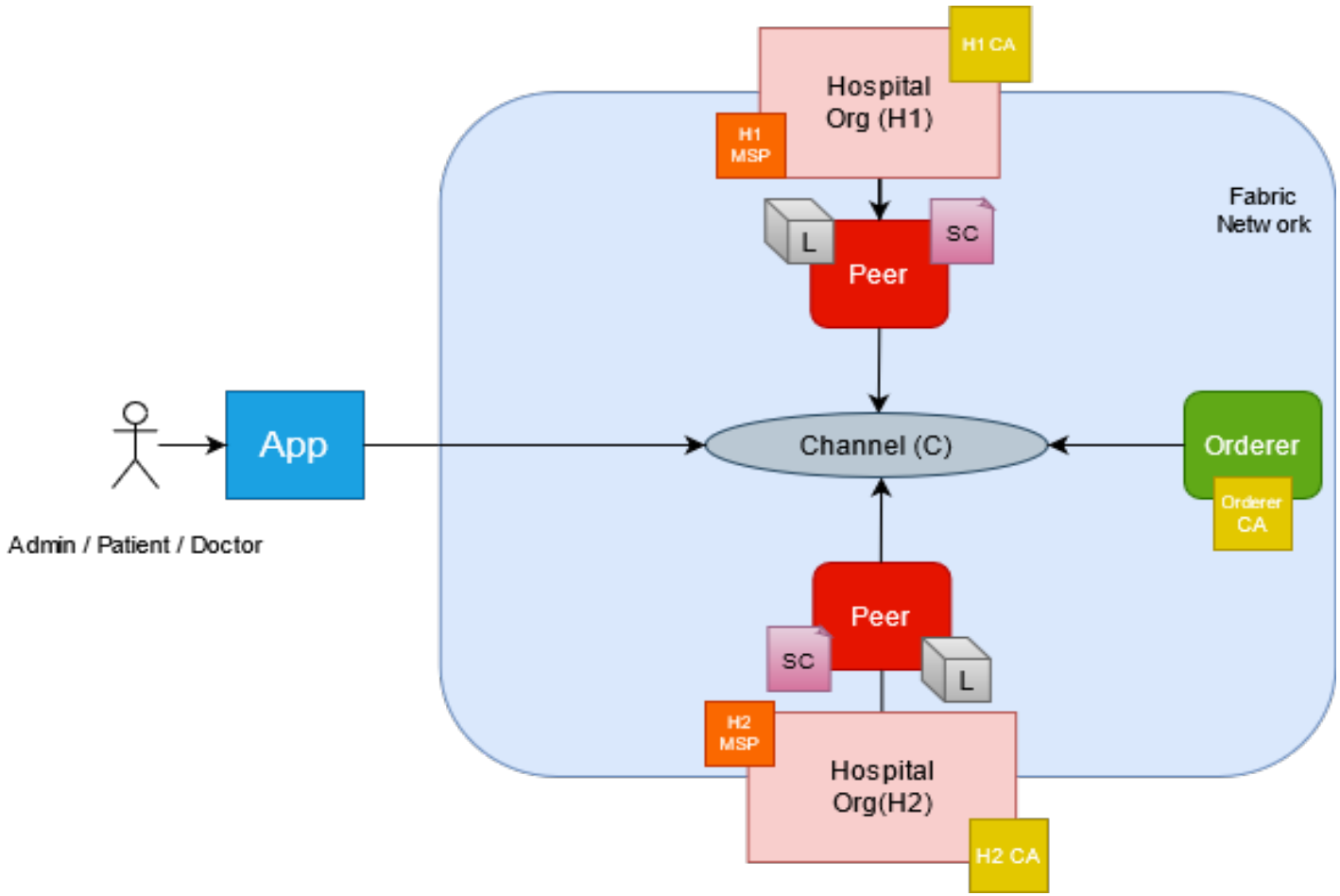

Figure: Product Architecture

Scenarios

- Scenario 1: Patient visits doctor1 in Hospital1 for the first time
- Scenario 2: Patient visits doctor2 in Hospital2
- Scenario 3: Patient has completed his/her treatment with doctor1

Data Structure in CouchDB

```
{
  "Record":{
    "PatientId":"patient1",
    "Address":"Address XX, 123 Street, City",
    "Telephone":17615945896,
    "Diagnosis":"Common cold",
    "Medication":"paracetamol",
    "DoctorAuthorizationList":[
      "doctor1"
    ]
  }
}
```

Smart contracts and Chaincode

- All the executable business logic for the application is implemented using smart contracts.
- Smart contracts are generally developed around the entity upon which the transactions are supposed to take place in the network.
- Create record for admin, read and update records for patients and doctors.
- Grand and Revoke access

Grant and Revoke Access

- Allows the patient to grant or revoke access to a doctor to his/her EHR.
- This is achieved by having an access control list in the EHR called DoctorAuthorizationList, which contains the list of IDs of doctors who are authorized to access that EHR.
- Only the patient will have access to this list.
- When a doctor tries to access or modify the EHR of a patient, the system checks the user ID of the doctor against the DoctorAuthorizationList in that EHR.

Software Development Kit

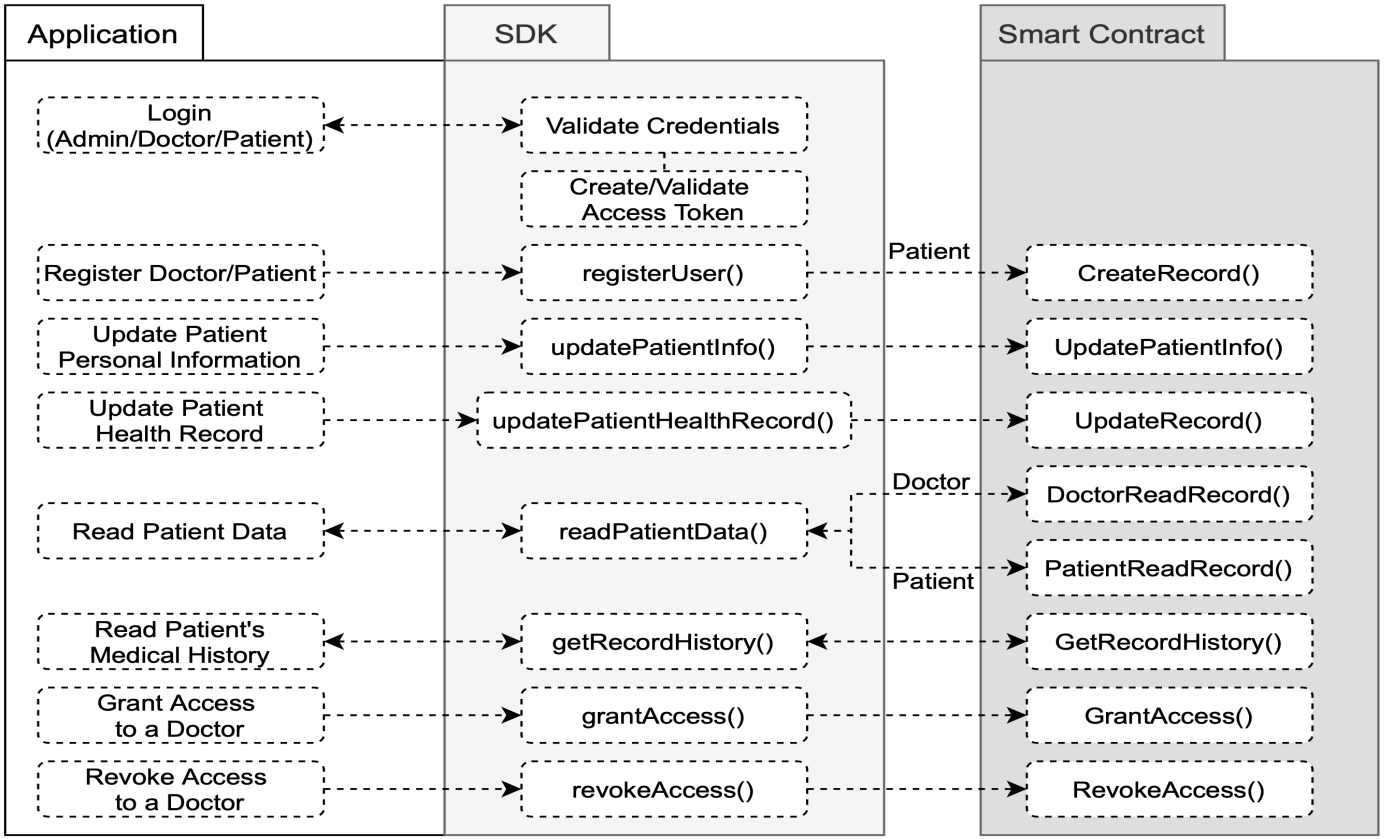

Figure: Application Programming Interface

Security

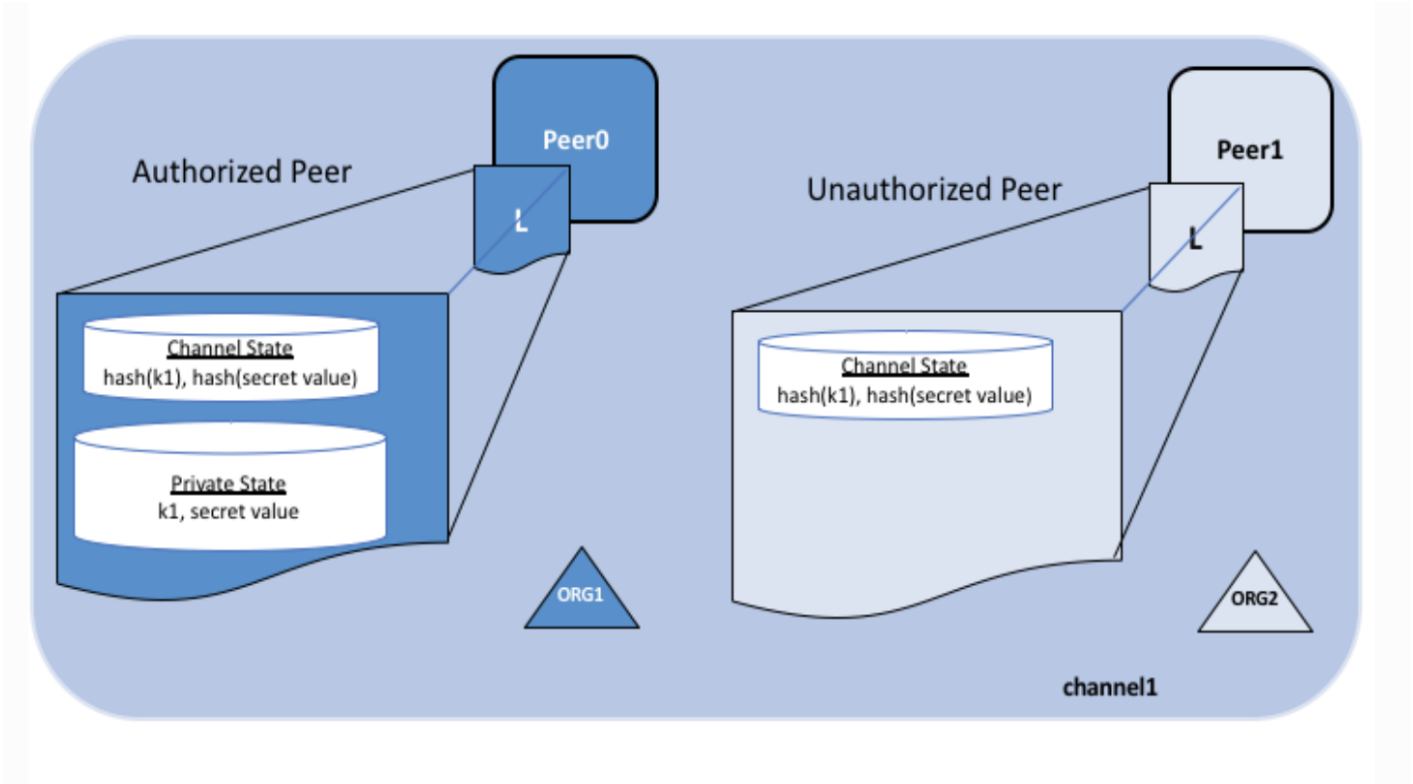

Figure: Private Data Collection

Source: https://hyperledger-fabric.readthedocs.io/en/release-2.2/private-data/private-data.html

Alternate solution for Private Data History

```
{
  "PatientID": "Patient1",
  "Address": "Address XX, 12345, City A",
  "Telephone": "123456789",
  "DoctorAuthorizationList": ["Doctor1","Doctor2"],
  "EHR":[{
    "RecordNo": "EHR1",
    "Diagnosis": "Diagnosis1",
    "Medication": "Medication1",
    "Timestamp": "DD.MM.YYYY",
    "DoctorId": "Doctor1"
  },{
    "RecordNo": "EHR2",
    "Diagnosis": "Diagnosis1",
    "Medication": "Medication2",
    "Timestamp": "DD.MM.YYYY",
    "DoctorId": "Doctor2"
  }]
}
```

Drawbacks

- JSON document as storage mechanism.(CouchDB/LevelDB)
- Further development is needed in terms of Hyperledger Fabric. For example: Private Data Collection
- Involvement of external agencies might impact the general workflow of the application.
- Scalability might become an issue.

Conclusion (1)

- Managing medical data electronically using a system based on Hyperledger Fabric is indeed an effective solution.
- EHR - private, sensitive and not alterable. Hyperledger Fabric - distributed, trusted and immutable.
- Another level of security - Auditable (getHistory)
- But...

Conclusion (2)

- Game-changer, but only when such systems are implemented at a full scale.
- Unfortunately, there remain some open issues:
  - getHistory not available for private data collection
  - Limited database options (CouchDb and LevelDB only)
  - performance issues like low maximum number of transactions possible per unit time
- Patient Data Management System is a feasible and indeed useful application in Hyperledger Fabric but there is some room for development within Hyperledger Fabric in this direction before we can have a finished product.

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Thank You!

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Q & A!

References

- https://hyperledger-fabric.readthedocs.io/en/release-2.2/private-data/private-data.html
- https://hyperledger-fabric.readthedocs.io/en/release-2.2/blockchain.html
- https://hyperledger-fabric.readthedocs.io/en/release-2.2/smartcontract/smartcontract.html